Iron and Steel ENGINEER

ENGINEERING SERVICE
TO THE IRON AND STEEL
INDUSTRY SINCE 1907

1010 EMPIRE BUILDING — December, 1943 — PITTSBURGH, PA.

TECHNOLOGY DEPT.

BETTER FINISH
INCREASED TONNAGE

Steel Mill operators rely upon the dependability of Lewis Rolls and Rolling Mill Machinery to help them speed up quality and quantity of production.

LEWIS FOUNDRY & MACHINE
DIVISION OF BLAW-KNOX CO.
PITTSBURGH, PA.

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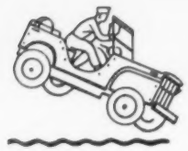
JAN 10 1944

ARMY E NAVY

LEWIS ROLLS

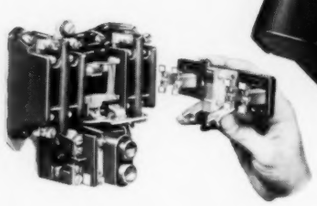


Air filters on jeeps are put there for just one reason . . . to keep 'em clean to keep 'em working. And keeping things working is the order of the day just *everywhere* today. In a busy arms factory it is more necessary than ever to keep vital motor control working. You can accomplish this by *working* on motor control to keep contacts clean. Or you can insist on Cutler-Hammer Motor Control with the VERTICAL *dust-safe* contacts that *shed* dirt and *keep themselves clean.* With unfailing motor control performance so important and manpower for maintenance so scarce, you too will be glad you insisted on Cutler-Hammer VERTICAL Contact Motor Control. CUTLER-HAMMER, Inc., 1269 St. Paul Avenue, Milwaukee, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

CUTLER-HAMMER
MOTOR CONTROL
C-H

Cutler-Hammer Vertical Contacts

OUT IN THE OPEN—NOTHING TO HIDE—You can see the *clean* contacts in Cutler-Hammer Motor Control as soon as you open the case. They're out in the *open* where they can work cooler and last longer.



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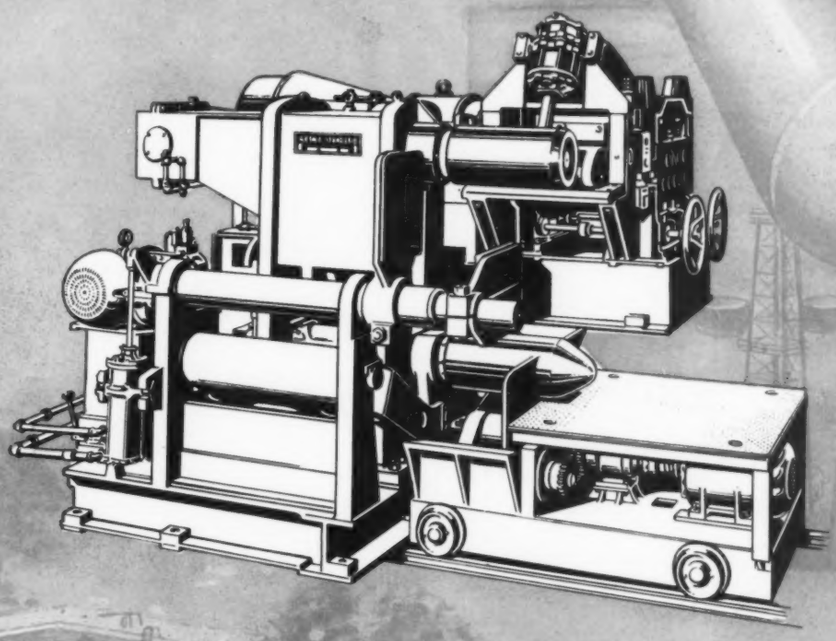
AETNA LOOKS TO FUTURE HORIZONS

THE AETNA UNCOILER and UNCOILING LEVELLER



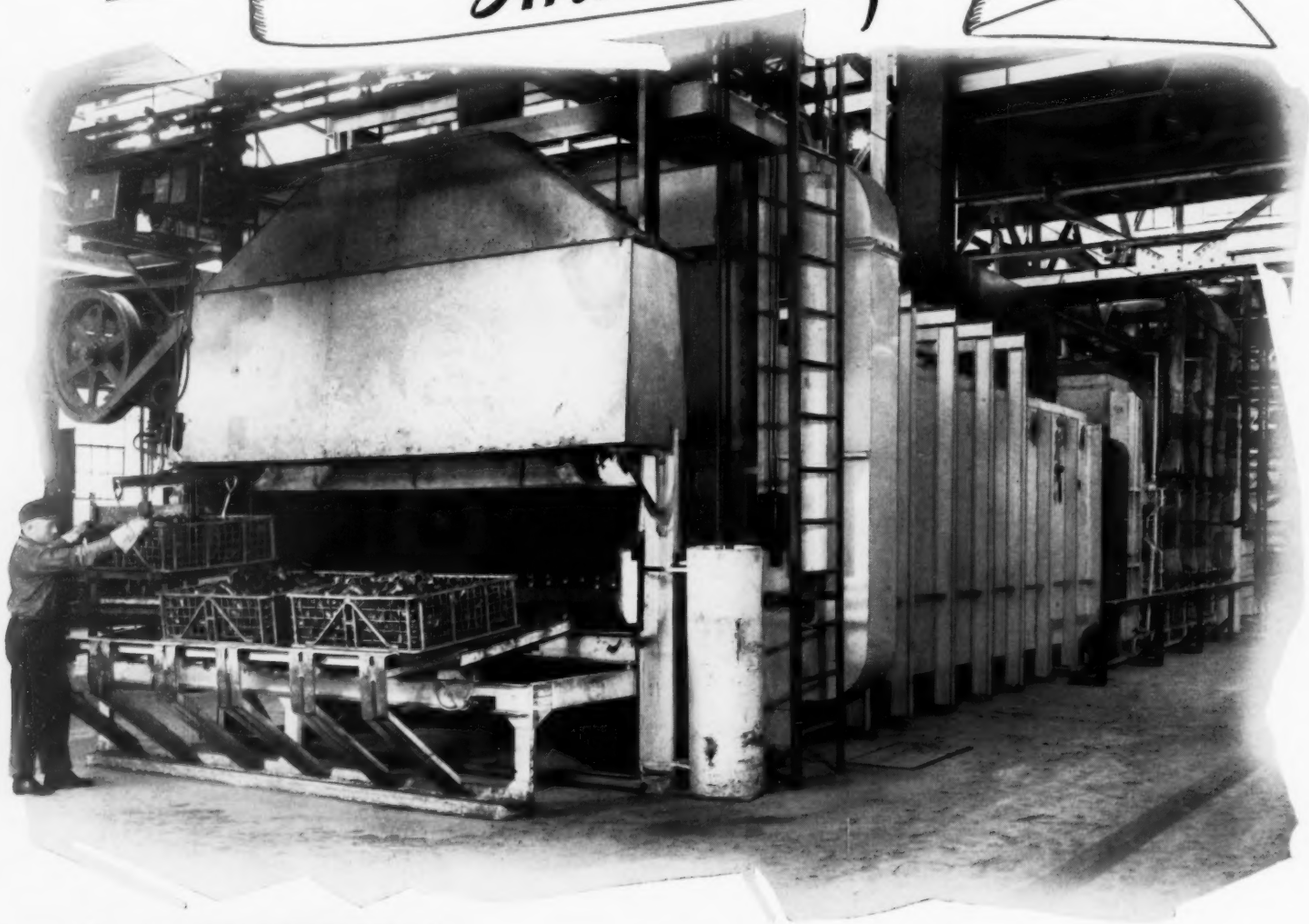
TODAY . . . bomb fins to hasten the destruction of our enemies . . . TOMORROW . . . parts for the ultra home of the future . . . The Aetna Uncoiler and Uncoiling Leveller for steel strip and skelp operating at speeds up to five hundred feet per minute today produces for tomorrow's victory and a new world for all.

The AETNA-STANDARD ENGINEERING COMPANY
YOUNGSTOWN · OHIO · U.S.A.
ARMY E NAVY

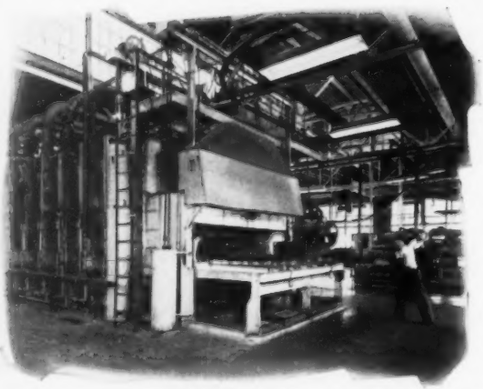
DESIGNERS AND BUILDERS TO THE STEEL, NON-FERROUS AND CHEMICAL INDUSTRIES

ASSOCIATED COMPANIES:
HEAD, WRIGHTSON & COMPANY, LIMITED, THORNABY-ON-TEES, ENGLAND
JOHN INGLIS COMPANY, LIMITED, TORONTO, ONTARIO, CANADA

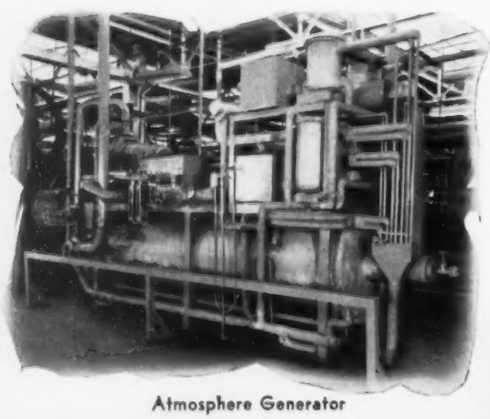
STEEL SHELL CASE *Annealing*



View from Discharge End



Charging End



Atmosphere Generator

THIS Wilson radiant tube heated, gas atmosphere control, continuous furnace is annealing over 5000 pounds per hour of steel shell cases and they are *scalefree* when they leave the furnace. In this operation, no pickling or washing is required between draws.

Write for details . . .

ENGINEERED AND CONSTRUCTED BY THE

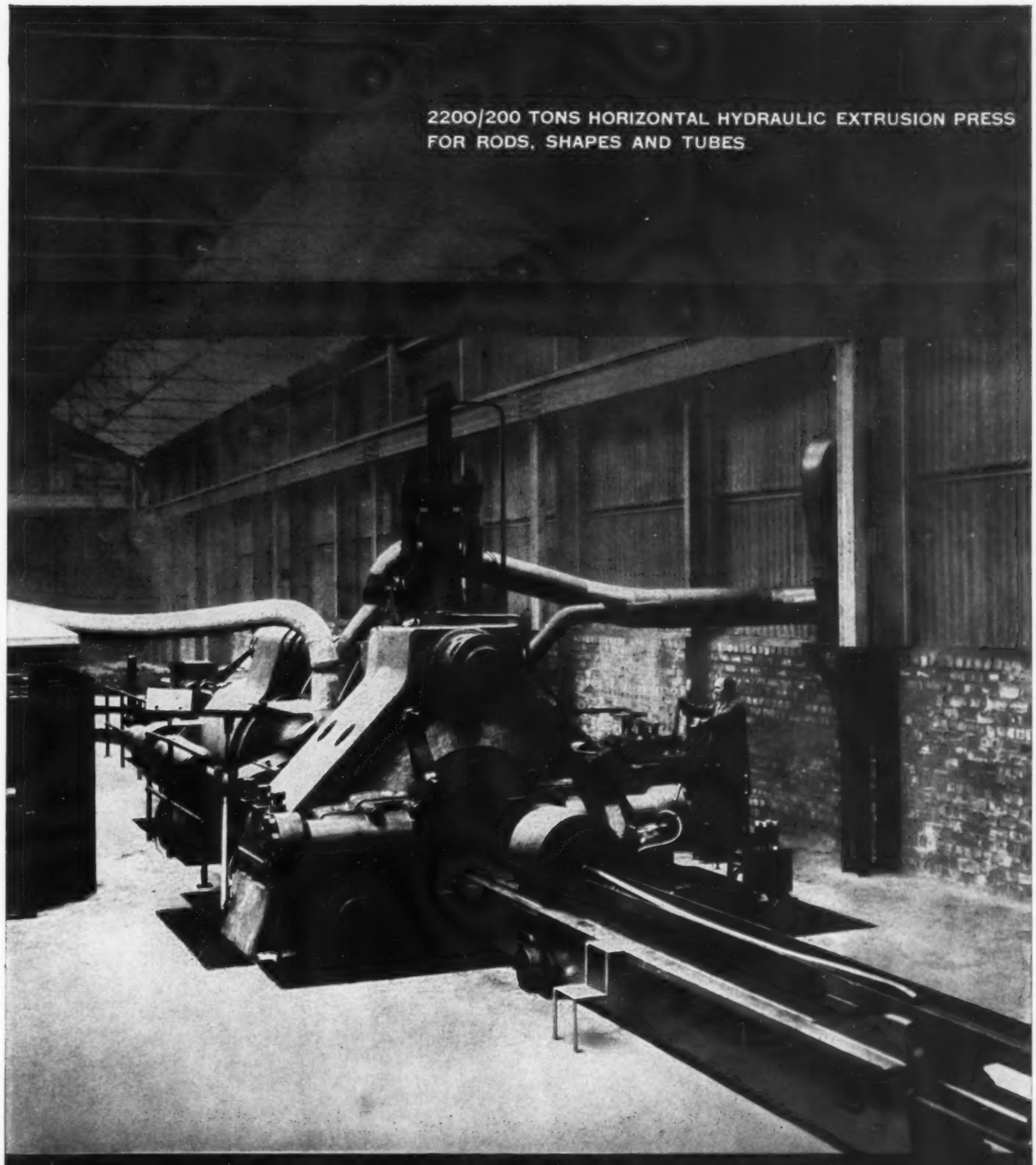
Lee Wilson ENGINEERING Co., Inc.

20005 West Lake Road CLEVELAND, OHIO

Telephone ACademy 4670

The Wilson Annealing Unit is covered by Patents Nos. 1,952,602, 2,068,477, 2,078,356, 2,081,612, 2,089,843, and other patents pending.

INDUSTRIAL FURNACES • RADIANT TUBE HEATING • HEAT TREATING PROCESSES



HYDROPRESS · INC.

ENGINEERS CONTRACTORS

HYDRAULIC PRESSES · ROLLING MILLS
STRETCHERS · PUMPS · ACCUMULATORS

570 LEXINGTON AVENUE · NEW YORK · N. Y.

*SPECIFIC

TIDEWATER LUBRICANIA

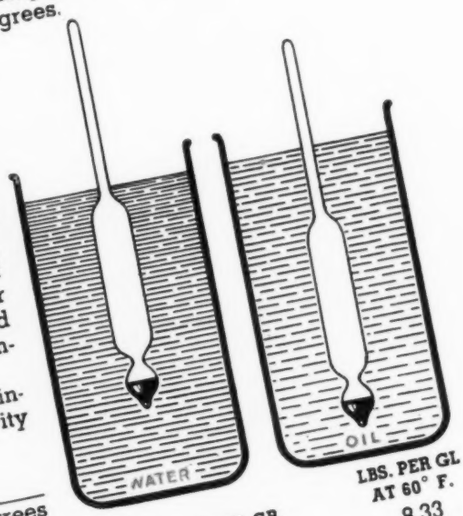
DEFINITION: The gravity or density of a liquid is a numerical value which enables the determination of the weight of a known volume of the product.

GRAVITY A. P. I. The gravity of petroleum products in the United States is generally obtained by means of a hydrometer graduated on the A.P.I. (American Petroleum Institute) scale. It is reported as Gravity in degrees A.P.I. Unless otherwise stated, it applies when the product is at a temperature of 60° F. If taken at a higher or lower temperature a correction is applied to reduce the reading to the standard 60° F. temperature.

The A.P.I. Gravity bears a definite relationship to specific gravity according to the formula:

$$\text{Sp. Gr.} = \frac{141.5}{131.5 + \text{A.P.I. degrees}}$$

The A.P.I. scale differs from the Baumé scale (used for non-petroleum liquids lighter than water) by only one-tenth to seven-tenths degrees.



EXAMPLES

	GRAVITY A.P.I.	SPEC. GR.	LBS. PER GL AT 60° F.
Water (distilled)	10°	1.00	8.33
Kerosene	36-40°	0.84-0.82	7.03-6.87
Machine Oil (paraffinic)	24-30°	0.91-0.88	7.58-7.30
Machine Oil (naphthenic)	18-22°	0.95-0.92	7.88-7.68

SIGNIFICANCE: Gravity is of little significance to the user. The quality or suitability of a lubricant is more readily appraised by other tests.

DRUMS! DRUMS! DRUMS!

War needs make it extremely important that all empty drums be returned immediately.

TYCOL lubricants are made from the most suitable materials and carefully refined to meet the most stringent laboratory specifications and service requirements. Scientific manufacture from the finest available material assures unvarying high quality in all Tycol lubricants.

TIDE WATER ASSOCIATED OIL COMPANY

Eastern Division: 17 Battery Place, New York 4, N. Y.
Principal Branch Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL

INDUSTRIAL TYCOL OILS-GREASES

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE **TYCOL**

GRAVITY

* This is the 6th of a series of informative messages concerning the meaning and significance of commonly used tests and terms employed to describe the characteristics of lubricating oils.

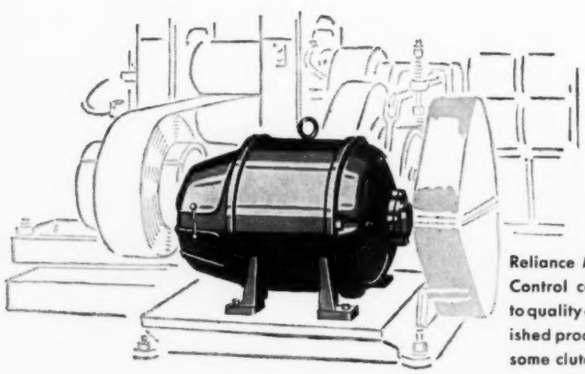
INDUSTRIAL LUBRICANTS

TENSION!

Tension Control can be an important production factor in the processing of such materials as metals, paper and cloth, which are wound on drums or cores. Tight, evenly-wound rolls and uniformity of the finished product often depend upon it.

All of the characteristics necessary to maintaining proper and constant tension control are inherent in Reliance Electric Motor-Drive.

The pioneering work done by Reliance engineers in putting motor-drive to profitable use along these lines proves again that motor-drive *can* be *more than power.* The results of their experience are available to you at any time.



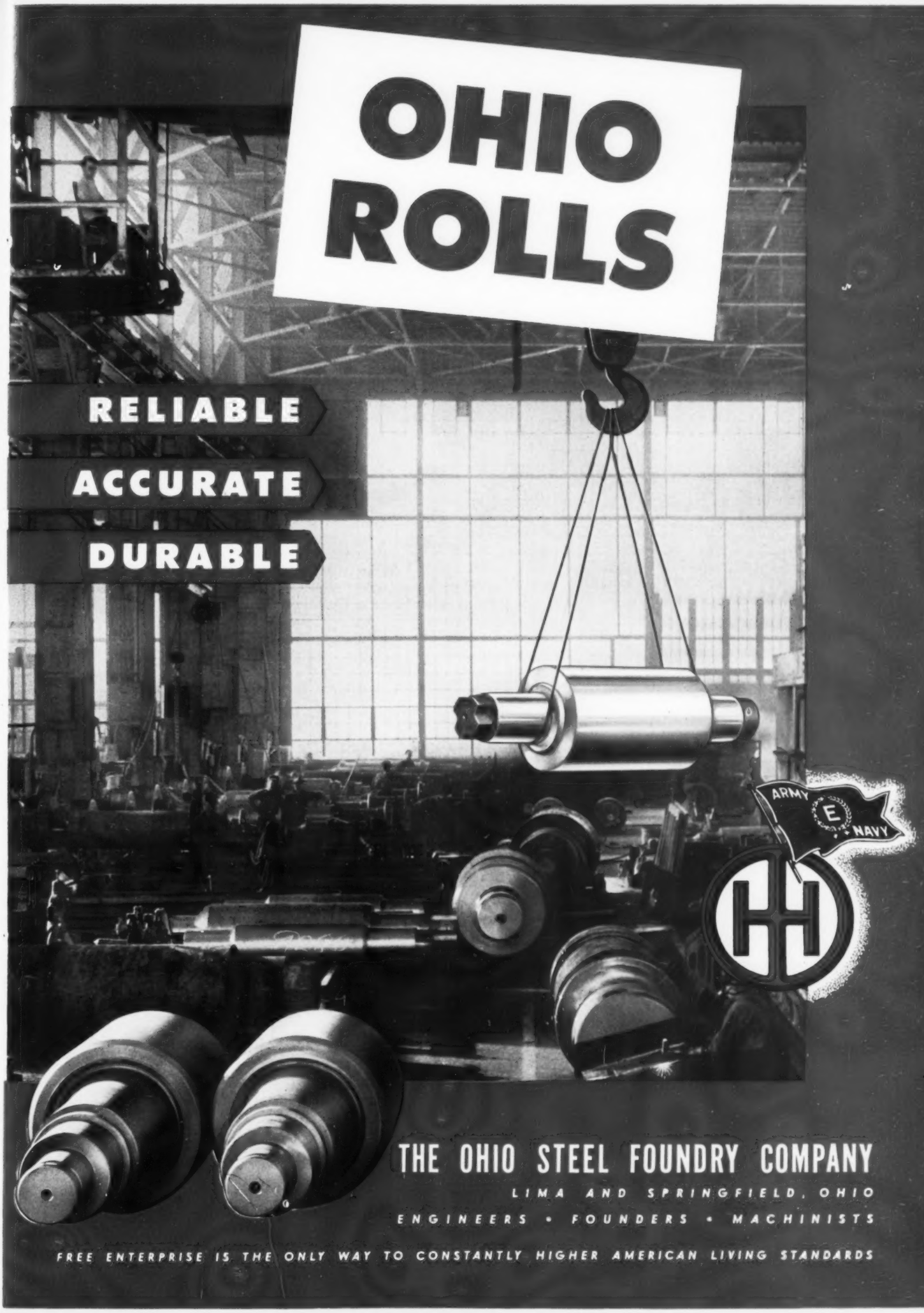
Reliance Motor-Drive for Tension Control contributes substantially to quality and uniformity of the finished product, eliminates troublesome clutches—and lowers costs.

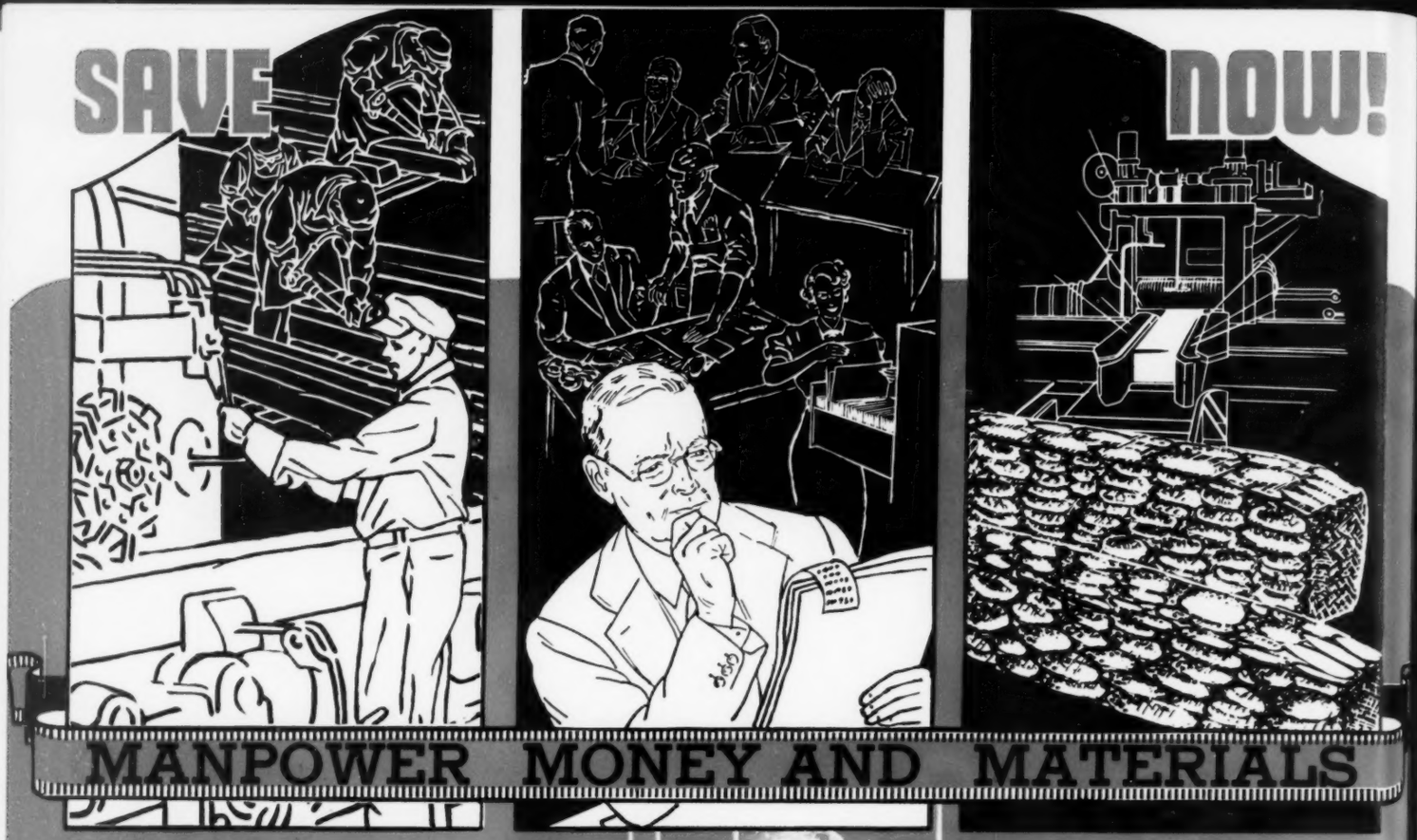
RELIANCE A·C D·C MOTORS

RELIANCE ELECTRIC & ENGINEERING CO.

1088 Ivanhoe Road · Cleveland, Ohio

Birmingham • Boston • Buffalo • Chicago • Cincinnati • Detroit • Greenville (S.C.) • Houston • Los Angeles • Minneapolis
New York • Philadelphia • Pittsburgh • Portland (Ore.) • St. Louis • San Francisco • Syracuse • other principal cities.


OHIO
ROLLS
RELIABLE
ACCURATE
DURABLE
ARMY
E
NAVY
THE OHIO STEEL FOUNDRY COMPANY
LIMA AND SPRINGFIELD, OHIO
ENGINEERS • FOUNDERS • MACHINISTS
FREE ENTERPRISE IS THE ONLY WAY TO CONSTANTLY HIGHER AMERICAN LIVING STANDARDS



MANPOWER SAVINGS are startling where the Billeteer takes over billet conditioning. In plants where the Billeteer has released hundreds of chippers for other essential duties, the bottleneck at the chipping point is removed and manpower is gained all along the line. The cutting head, at 120 bites a minute, makes short work of seams and defects. RESULT—a saving in manpower of 18 to 20 men per turn for each Billeteer.

MONEY SAVINGS, considering the initial investment in the Billeteer, have many profit angles. Starting with improved tonnage, there are savings in less personnel, payroll and accounting records, less tools, maintenance and supplies, less chance for absenteeism and legal action resulting from accidents and disability. RESULT—a Billeteer pays out in 8 to 12 months.

MATERIAL SAVINGS are vital to the war effort! Today when key men are being drafted and specifications are tougher than ever, bad heats are frequent and their reclaiming is a grueling, unprofitable task without a Billeteer for complete surfacing. It just takes about 30 days for a Billeteer to save its weight in good saleable scrap. Consider too the material savings in tools, supplies and maintenance for twenty chippers. RESULT—you are paying for a Billeteer, might as well have its many savings.

* * *

The Billeteer is so vital to steel tonnage that the W. P. B. allocates each one. Let us assist you in lining up a delivery. Some amazing facts await you.

THE BONNOT CO. — STEEL EQUIPMENT DIVISION — **CANTON, OHIO**

BONNOT

ENGINEERED FOR IMPROVED PRODUCTION

Typical casting for a Yale & Towne hoist, malleableized in a furnace whose temperature is accurately recorded by a Micromax Pyrometer at right. Yale & Towne has for many years relied on Micromax Pyrometers to give the accuracy required in heat-treatment of high-grade parts for their various products.

A glance at the Micromax Recorder tells both foreman and operator just what is going on in the malleableizing of castings like the one shown at left.

MALLEABLE-IZING?

Because the malleableizing of castings is a long-drawn-out process, the self-checking features of Micromax Pyrometers have a special value for both the company management and the furnace operator. True, the operator keeps an eye on the whole process — but think of the added safety when the pyrometer also keeps an eye on itself! And that's just what Micromax does — checks itself and reports on its own condition, as part of its main job of checking and controlling temperature.

This self-checking begins with automatic standardizing of the pyrometer's measuring circuit. This is done so frequently that any needed adjustment in the instrument's temperature curve is usually invisible; the instrument is in effect always standardized; there's no "human equation" to influence either the accuracy or the promptness of standardizing.

Self-checking also includes automatic signalling when, at intervals of several weeks, fresh chart, ink and batteries are required. And the Micromax also signals if its electric power is off; a particularly useful feature when temperature is changing so slowly that the pen motion is hard to see. This is of course a standard condition in normalizing, annealing and various other processes in which industry employs thousands of Micromax Pyrometers for accurate, sensitive, dependable control of temperature.

Micromax can serve as Recorder, soak-point Controller or Program Controller. As a Program Controller it regulates both heating and cooling rates as well as soak; and either heating or cooling can be interrupted by soak periods if desired. In a word, if a given cycle of furnace operation is humanly possible, Micromax can control it better than the best human.

If you have a temperature-control problem, outline it to us and an L&N engineer will gladly try to help solve it. Or, if a compact, fact-filled catalog meets your needs, we will send the appropriate one on request.

Fully automatic control of heating, soaking and cooling is recorded on this Micromax Program Controller. The cycle shown on the Recorder is of course for a much shorter process than malleableizing; it was selected because of the clearer over-all picture it presents.

Jrl Ad N-33-666(3)

ARMY NAVY *depends on me!*

A Slogan For Every American

LEEDS & NORTHRUP COMPANY, 4942 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

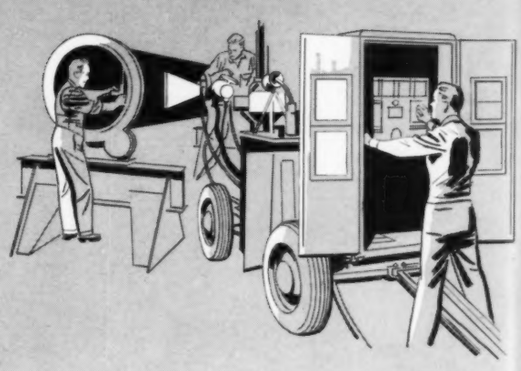
Controlling Cross Section . .

NEWS OF WESTINGHOUSE SERVICES AND PRODUCTS FOR THE STEEL INDUSTRY

ON-THE-SPOT INSPECTION

X-RAY—Heavy-duty mobile unit speeds the production of vital war products by "looking inside" to discover blowholes, cracks, shrinkage areas and porosity—before valuable man-hours, machine-hours and material have been wasted in further machining operations. Ultra-high-speed x-ray permits radiographs to be made through one inch of steel at a speed of one-millionth of a second. For details, ask for Booklet B-3258.

Westinghouse



. . ACCURATELY AND QUICKLY WITH AUTOMATIC SCREWDOWN

Multiple-stand, continuous mills for all types of plate and structural sections are winning America's battle of production, chalking up records believed impossible in pre-Pearl Harbor days. Yet the pace was not slow, even then—and this ever-increasing speed will not slacken in a post-war world.

The key to such increased production is common to many other industrial problems; the margin for human error must be decreased; the controls must be governed by faster, more accurate means than human hands. Complex operations must be made more nearly automatic to insure maximum speed and uniformity of product.

Translated into terms of the specific requirements for continuous rolling mill operation, screwdown settings must be made accurately and must be the same amount for each successive piece rolled. Such settings control the gauge or cross section of the piece being rolled, and the speed and accuracy with which these settings are made has an important bearing on the over-all production rate.

The Westinghouse answer to this problem is the Automatic Screwdown. By means of this device the settings for each pass of a particular rolling schedule are preselected on one of two plug selector panels arranged beside the roller's control benchboard. Then, during the rolling of each piece the screwdown is automatically advanced to the next pass position, merely by advancing the pass selector master switch from point to point. The second plug selector panel may be used to set up a new schedule while the mill is being operated on the schedule setup of the other panel. In this way, there is no delay in production while selection of pass positions is being made.

Through long and intimate association with the steel industry, Westinghouse engineers have gained a wealth of experience in solving such problems. They stand ready to be of similar service to you; just phone your nearest Westinghouse office. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pennsylvania.

J-94588

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

WESTINGHOUSE ENGINEERING SERVICE

A nationwide corps of engineers offers you electrical and production experience gained through years of working with the steel industry.

In addition to engineering help on specific industry problems involving electrical power, these men can give you assistance on these other vitally important activities:

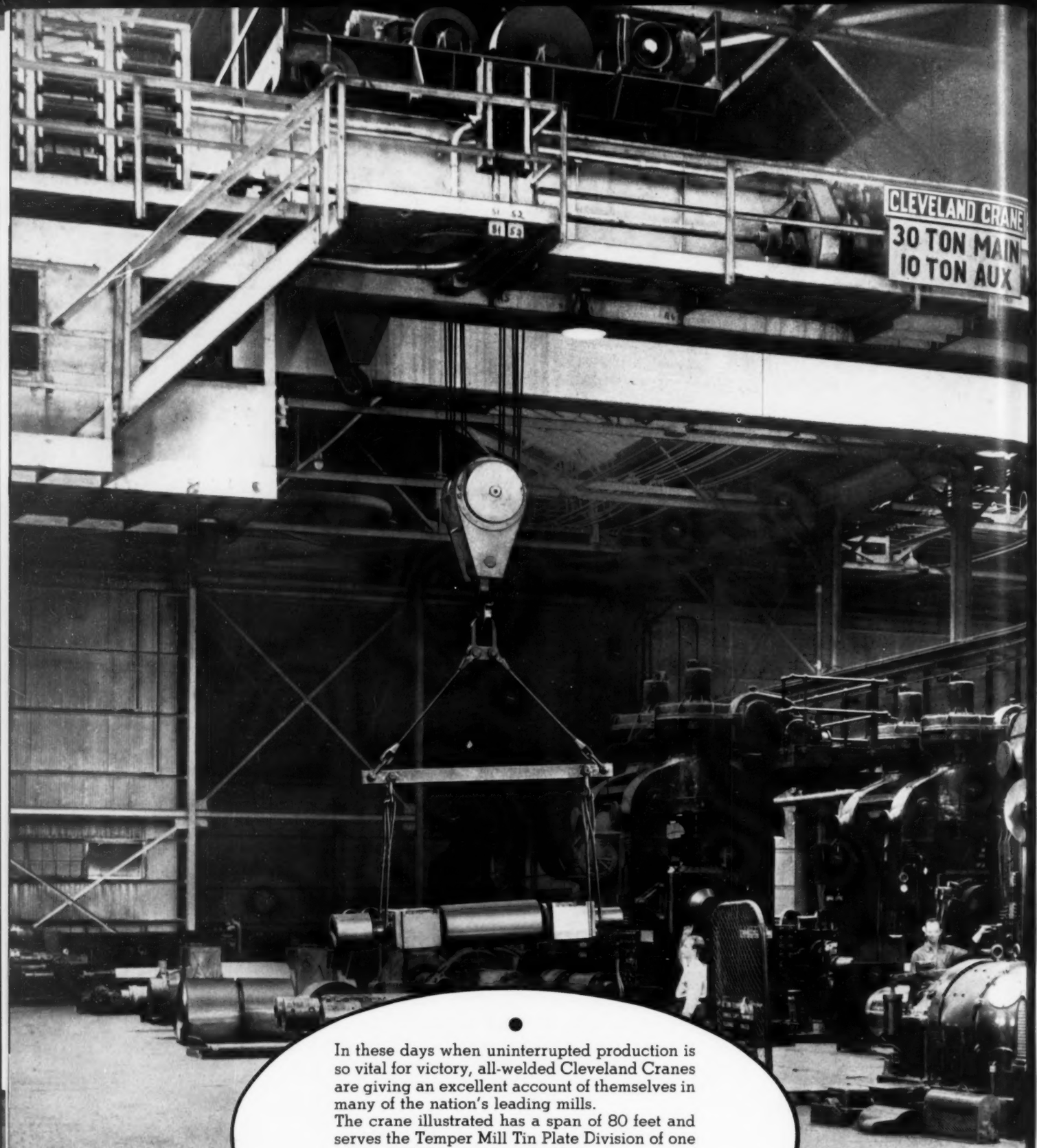
PRODUCT DEVELOPMENT: engineering of equipment to meet war requirements.

MAINTENANCE: help in making existing equipment serve better, last longer.

REHABILITATION: redesigning and rebuilding obsolete equipment for useful service.

MATERIAL SUBSTITUTION: adapting available replacements for critical materials.

W.E.S. is available to all branches of the steel industry. Put it to use today on your production problems.



In these days when uninterrupted production is so vital for victory, all-welded Cleveland Cranes are giving an excellent account of themselves in many of the nation's leading mills.
The crane illustrated has a span of 80 feet and serves the Temper Mill Tin Plate Division of one of the world's largest steel mills.

THE CLEVELAND CRANE & ENGINEERING CO.
1131 EAST 283 RD ST. WICKLIFFE, OHIO

CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

Crops and Shorts

WITH the shutting down of a number of open hearth furnaces here and there around the country comes a variety of reasons which seems to be doing its best to list every possible premise except the right one.

▲

THE problem has changed from how to get more steel to what can be done with all the steel that can be produced. With the electric furnace program not quite completed, come indications that there will be excess capacity of 200,000 tons per month (about 40 per cent of the total) during the first quarter of 1944. Still the orders restricting the use of steel are maintained. Just how the production of some steel for window sash or bedsprings might retard the production of rather tight plates and tubes is a mystery of WPB thinking.

▲

THREE strikes don't mean out in the case of John L. Lewis with his four coal strikes — or is it because they were foul?

▲

MAN-HOURS for the production of steel have dropped from 67.3 per ton in 1902 to 33.0 per ton in 1942, according to E. M. Voorhees, United States Steel Corporation. Meanwhile, the basic common labor rate has increased more than seven-fold. The price of bessemer billets in 1902 was about $30.00 per ton. Open hearth billets in 1942 were priced at $34.00 per ton. Interesting figures — and it doesn't take a New Deal economist to figure out who has profited most.

▲

ISN'T it odd that, in comparing living costs with wages, the hourly rate is always used, while the total income is ignored? Weekly income in The United States Steel Corporation now averages $50.42 per week as compared with $33.01 per week in January, 1941, according to B. F. Fairless. This is an increase of 52.7 per cent per week, or more than double the reported advance in the cost of living. Even the hourly rate has risen to a greater extent than has the cost of living index. Still the requests come for higher rates.

▲

AN increase of 17 cents an hour in the base rate; a guaranteed minimum weekly income; severance pay; more liberal vacation with pay; lunches at cost; sick leave with pay; more holidays; premium wages: 5 cents an hour for the afternoon shift, 10 cents an hour for the night shift; preference to union officials for promotions — these are the main items in the demands of the United Steelworkers of America. Apparently, they haven't discovered how big a hole work makes in the day. If granted, these demands would make supervisors rue the day they were promoted. Of course, a big list leaves lots of room for concessions and compromise.

▲

REMEMBER when you wondered why the old man was content to sit home at night and read the paper?

▲

ONE crystal gazer reports a post-war production level of 69,500,000 net tons of ingots per year. Other industries are to be at similarly substantial levels, national income at a remarkable $112,000,000,000 — yet it will seem like a depression from the wartime peaks.

▲

THE transition period from wartime production peaks, through the reconversion and demobilization period, to the real post-war period, however, promises some headaches and unemployment, probably starting early next year. There is much talk and advice about post-war planning, some of it sound, some of it meaningless mouthings. In the former class is Analysis No. 31, "Your Business After the War," published by the Research Institute of America. The pamphlet has much solid material, with observations and recommendations of a rather specific nature. This type of information, coupled with an announcement of government policy regarding reconversion, will do much to ease us over the bumps.

▲

AMONG the many return cards from the "Iron and Steel Daily News" of last September are two from the Buffalo district asking for more information on how to get a raise in pay. If any of our readers know the answer, let us in on it, too — or should we just forward the cards to Phil Murray?

▲

WHILE we can't settle the argument about what football coach originated the man in motion, we feel that Mrs. Roosevelt has carried it further than anyone else.

▲

FAVORABLE reports have been given by engineers of the Bonneville Power Administration for wrought iron bus bars, which they have used in place of scarce copper and aluminum.

▲

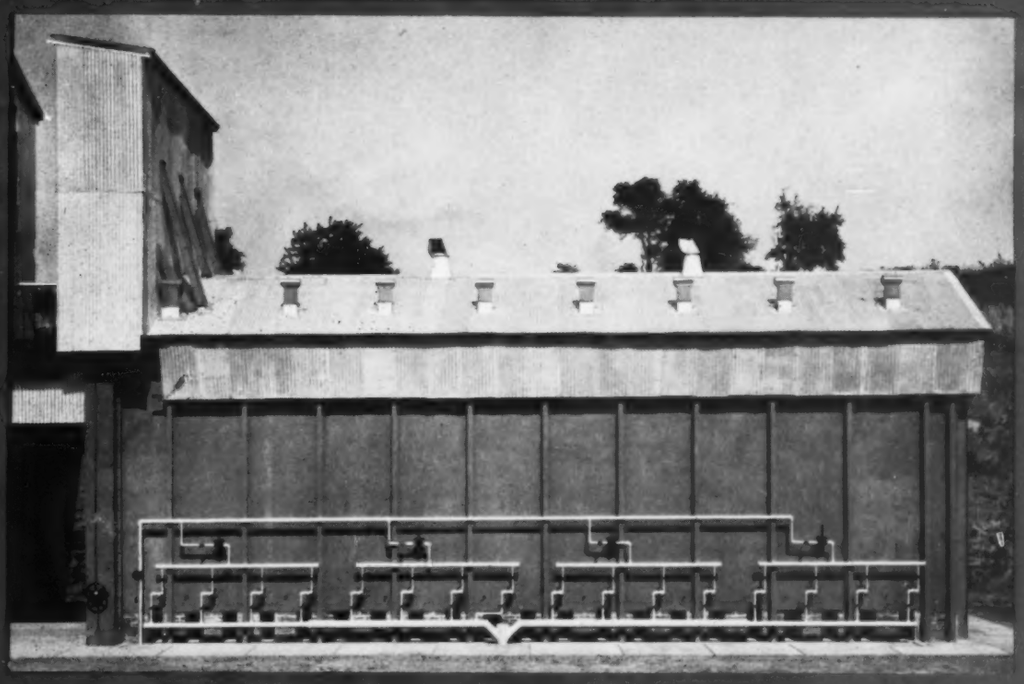
TREASURY silver, made available to essential industry under the Green Act, is being used to considerable extent in engine bearings, brazing alloys, solders, etc.

Our nation's plans for victory call for steel and more steel—
SPEED PRODUCTION WITH PITTSBURGH ROLLS

PITTSBURGH ROLLS

PITTSBURGH ROLLS DIVISION of
BLAW-KNOX CO—"Steel's Partner" • PITTSBURGH, PA.

HEAT-TREATING *and*
STRESS-RELIEVING *under*
Precision Control
to meet EVERY DEMAND
of your WAR-TIME PRODUCTION!



SWINDELL
GAS FIRED
CAR BOTTOM
FURNACES

SWINDELL-DRESSLER *Corporation*
DESIGNERS AND BUILDERS OF MODERN INDUSTRIAL FURNACES
PITTSBURGH, PA.

BIG MEDART STRAIGHTENER USES 30 TIMKEN BEARINGS

Resistless force! When this Medart No. 9 Straightener goes to work the toughest steel bar has no choice but to yield.

To make the big machine's task easier; to save power; to cut maintenance; and increase endurance; 30 Timken Tapered Roller Bearings are used. They are applied at the following positions: rolls, 4 (4-row); gear drive, 10; couplings, 16.

This is another outstanding instance in the steel industry where the ability of Timken Bearings to minimize friction and wear; to safely carry radial, thrust and combined loads; and to hold moving parts in correct and constant alignment; is paying dividends to equipment operators. Are *you* getting them? The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Equipment manufacturers: Beat post-war competition to the punch; step up machine performance with more Timken Bearings.

THUNDERBOLTS

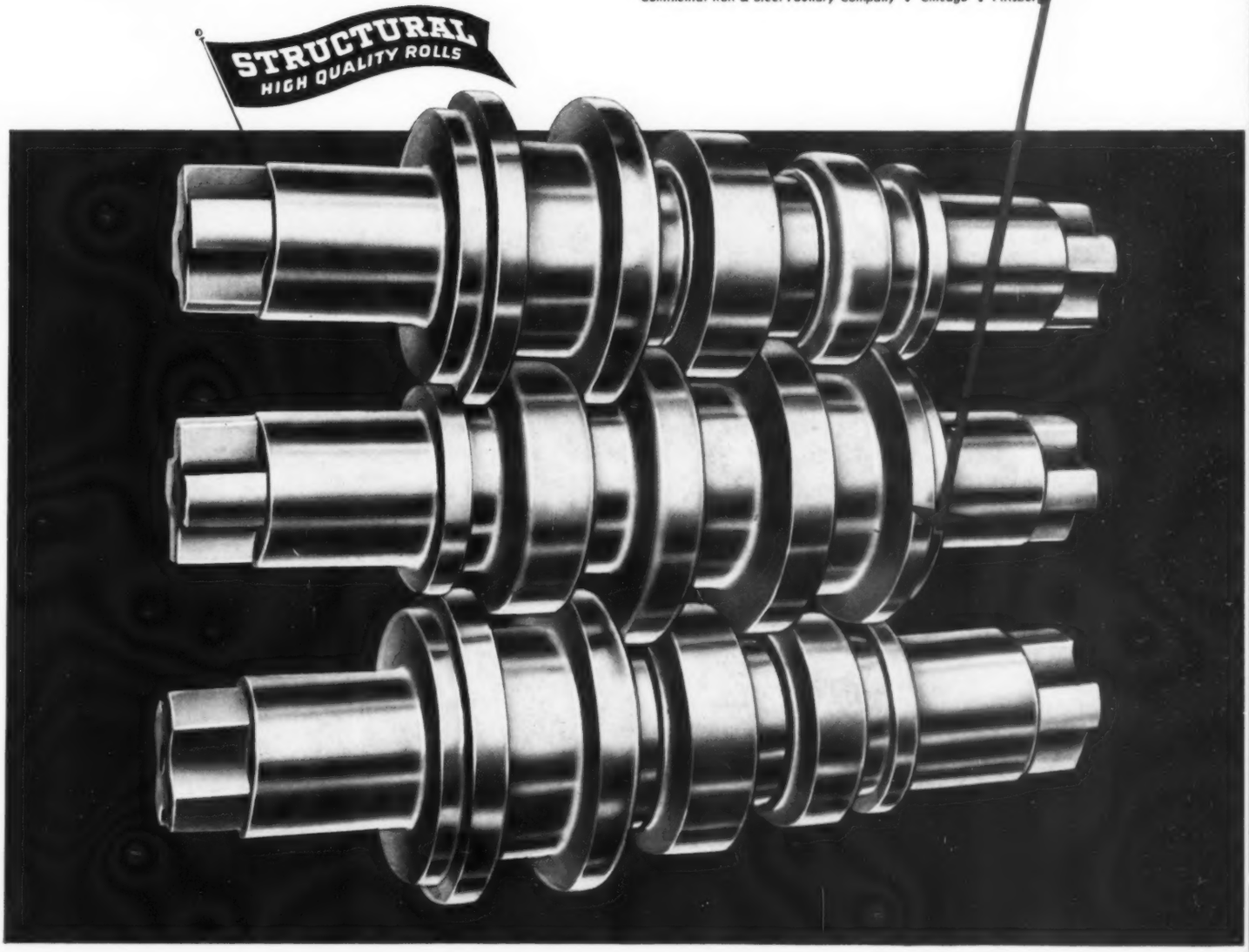
OF STEEL PRODUCTION—CONTINENTAL ROLLS

The mighty Thunderbolts are writing new pages of glory with our armed forces. They're handling the more important missions on many fronts with precision—and dispatch!

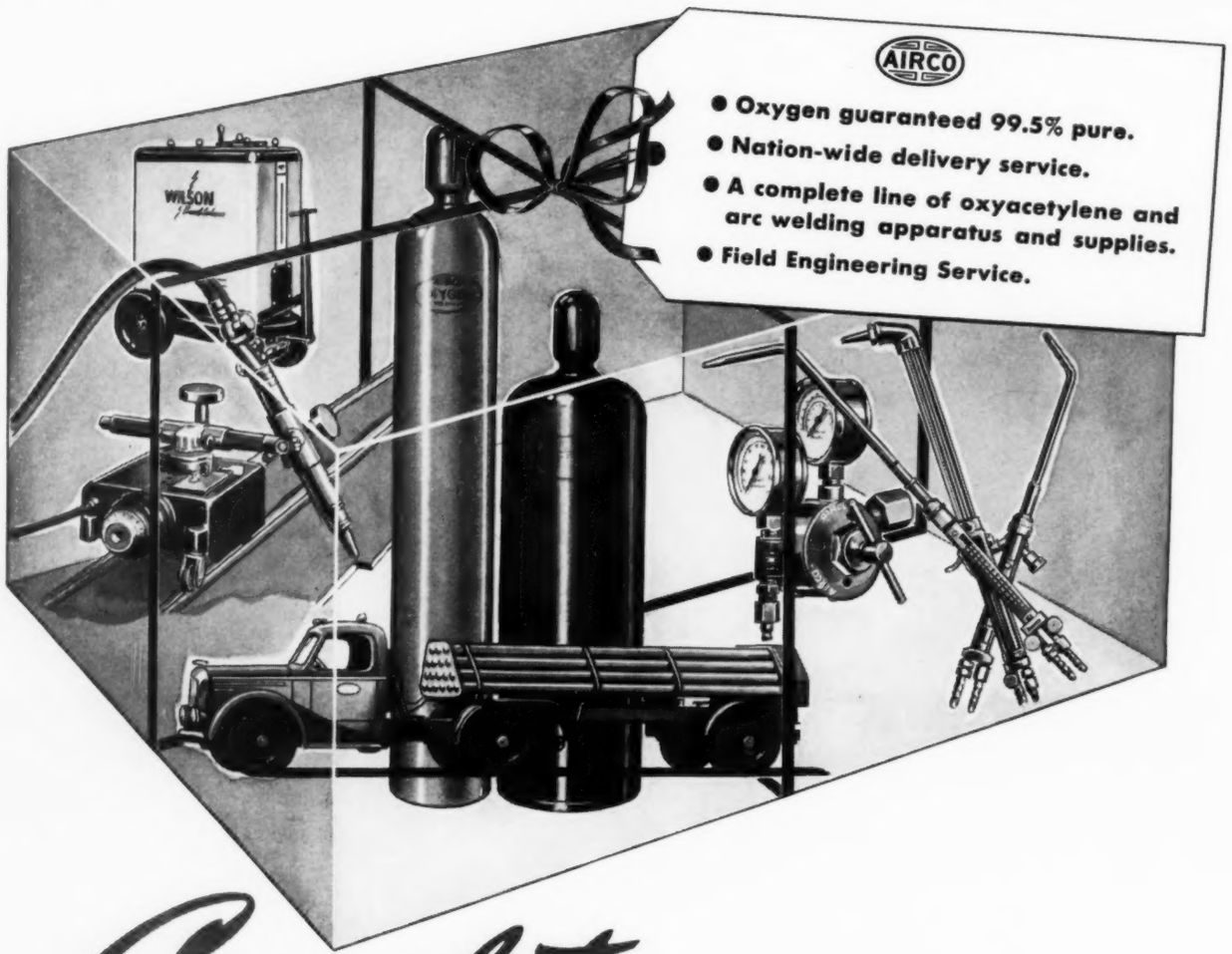
Also champions in their own right, *Continental Rolls* are today expediting production in hundreds of mills throughout America. And, they're delivering this greater tonnage with longer roll life and lower production costs.

Continental has long been recognized for leadership in the roll field—as manufacturers of quality rolls of all types to meet individual specifications. It will pay you to specify Continental for your next roll installation.

Continental Roll & Steel Foundry Company • Chicago • Pittsburg



CONTINENTAL ROLL & STEEL FOUNDRY COMPANY


AIRCO
• Oxygen guaranteed 99.5% pure.
• Nation-wide delivery service.
• A complete line of oxyacetylene and arc welding apparatus and supplies.
• Field Engineering Service.
WILSON

A *Complete* OXYGEN SERVICE IN ONE PACKAGE...

Whether your needs are for 200 cu. ft.—20,000—or several million cubic feet of oxygen monthly, Air Reduction's complete service meets all your oxygen needs.

Airco oxygen is guaranteed 99.5% pure . . . uniform from coast to coast. It assures maximum speed and economy in metal cutting . . . promotes greater efficiency in welding. Airco's nation-wide network of offices and plants assures dependable deliveries to any point in the nation.

Air Reduction also manufactures a complete line of apparatus and supplies for welding, cutting and all other applications of the oxyacetylene flame and electric arc. In addition, its nation-wide Field Engineering Service offers technical aid—including development of mechanical flame and arc applications and design of gas pipeline systems for your plant.

Whatever your need for oxyacetylene welding and cutting, Air Reduction's complete service will meet all your requirements. There's an Air Reduction office located within close reach of your plant.

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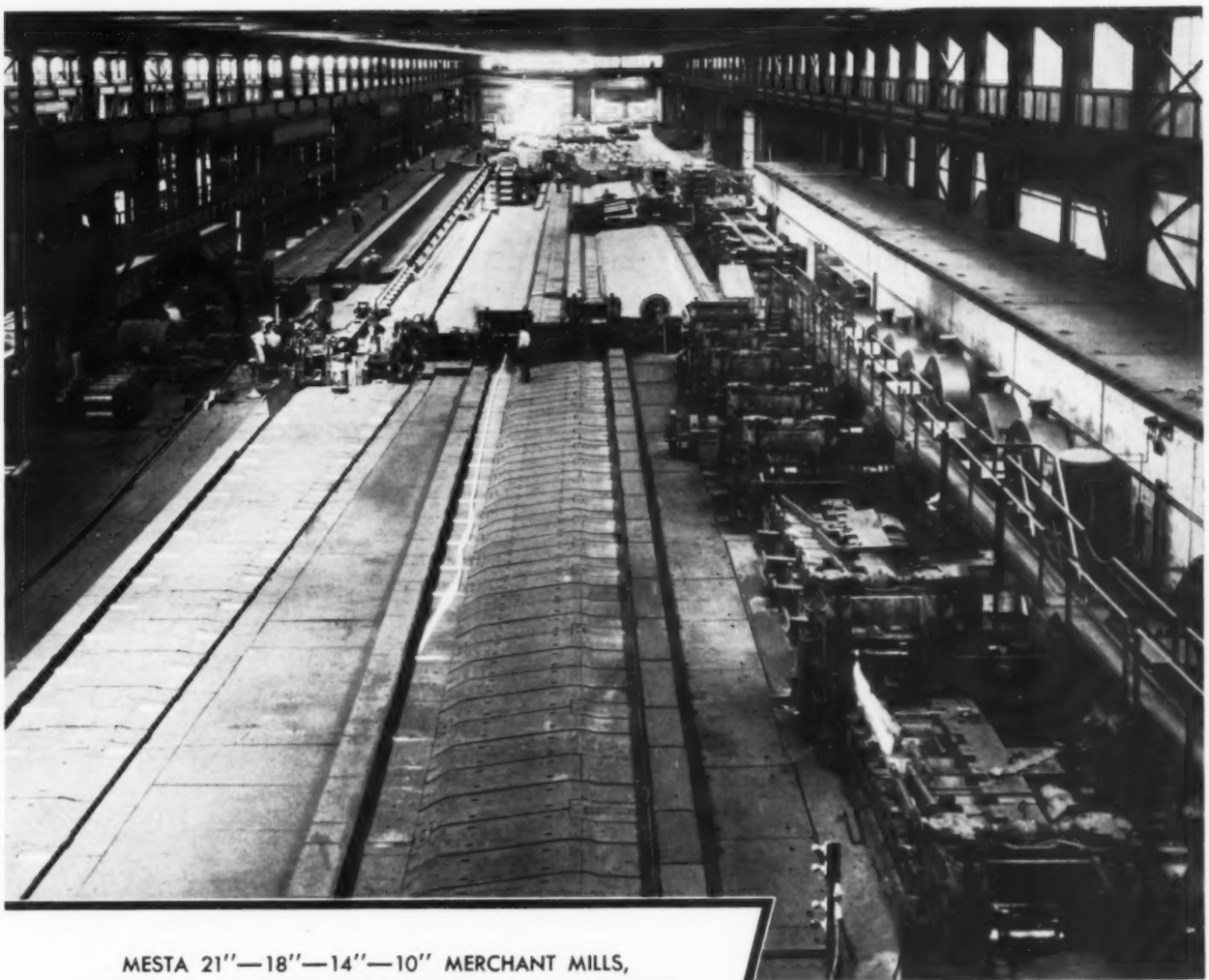

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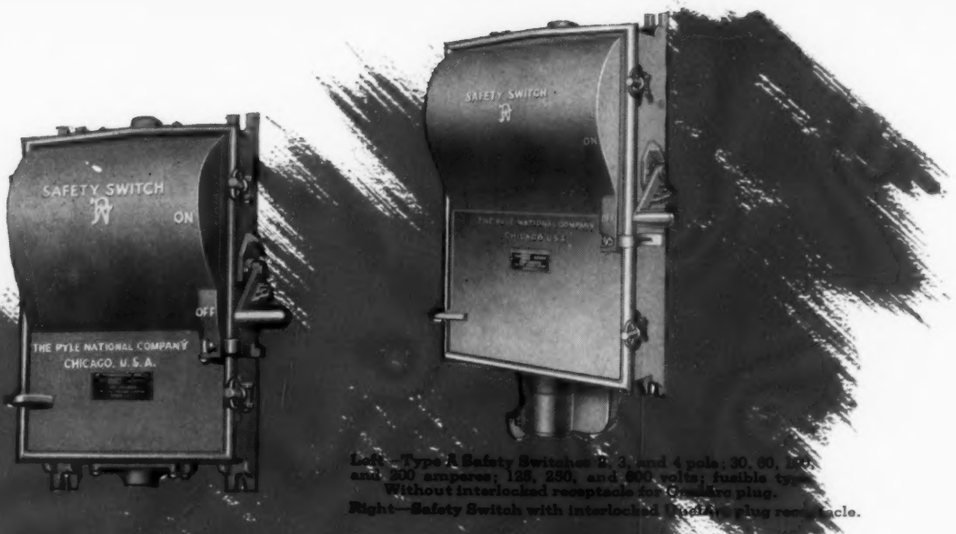

Left—Type A Safety Switches 2, 3, and 4 pole; 30, 60, 100, and 200 amperes; 125, 250, and 600 volts; fusible type. Without interlocked receptacle for QuelArc plug.
Right—Safety Switch with interlocked QuelArc plug receptacle.

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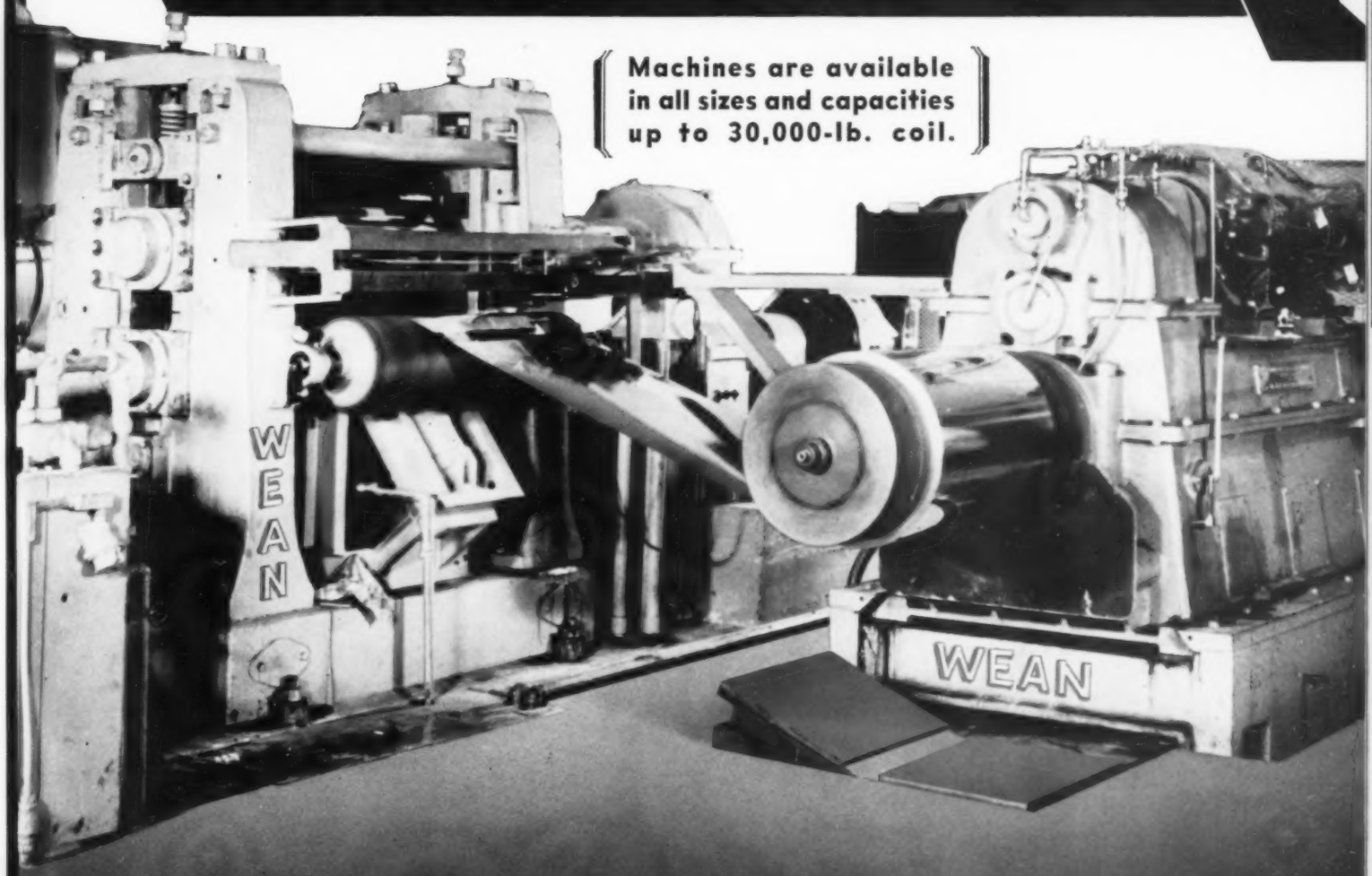

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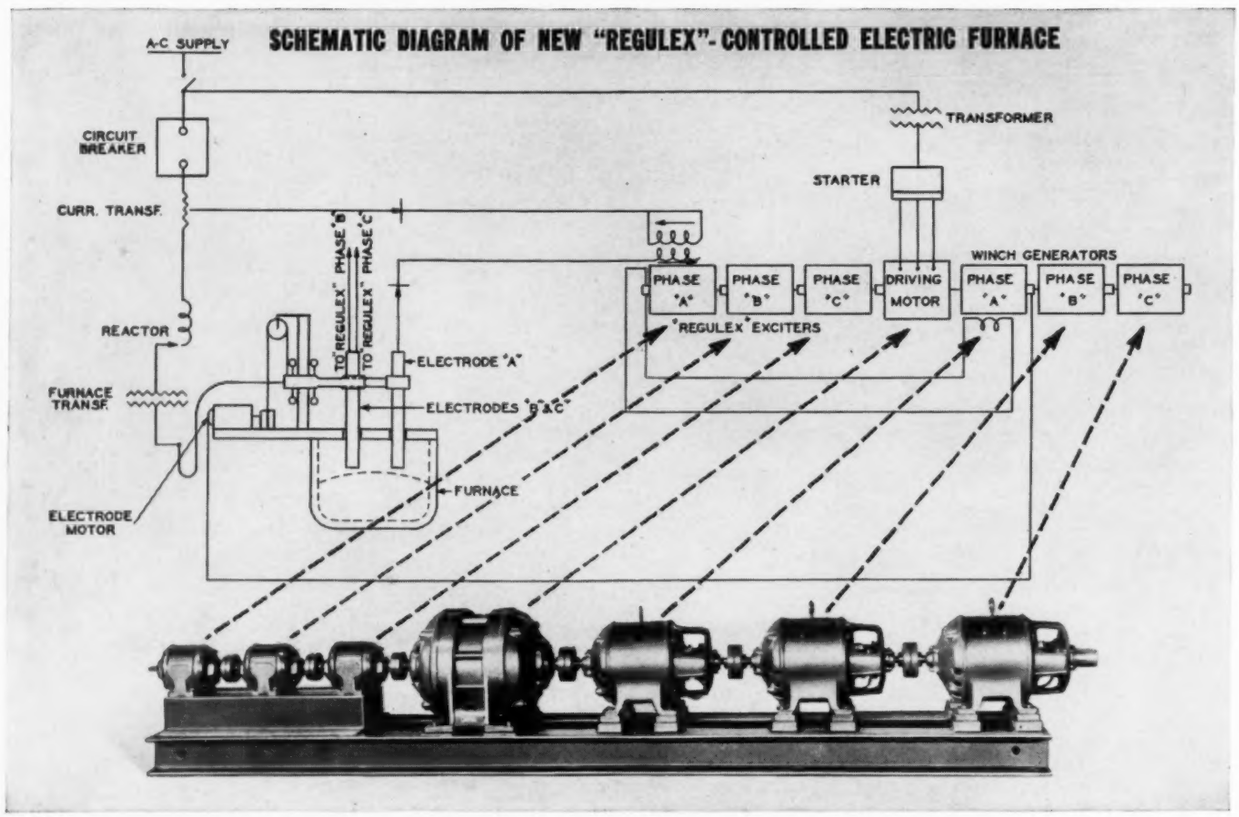

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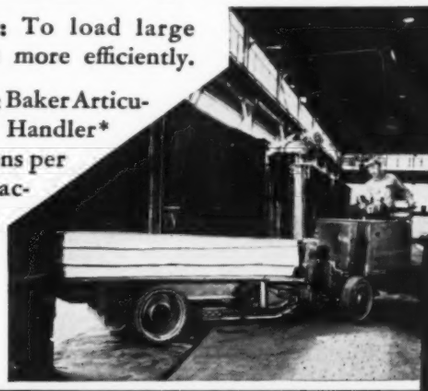

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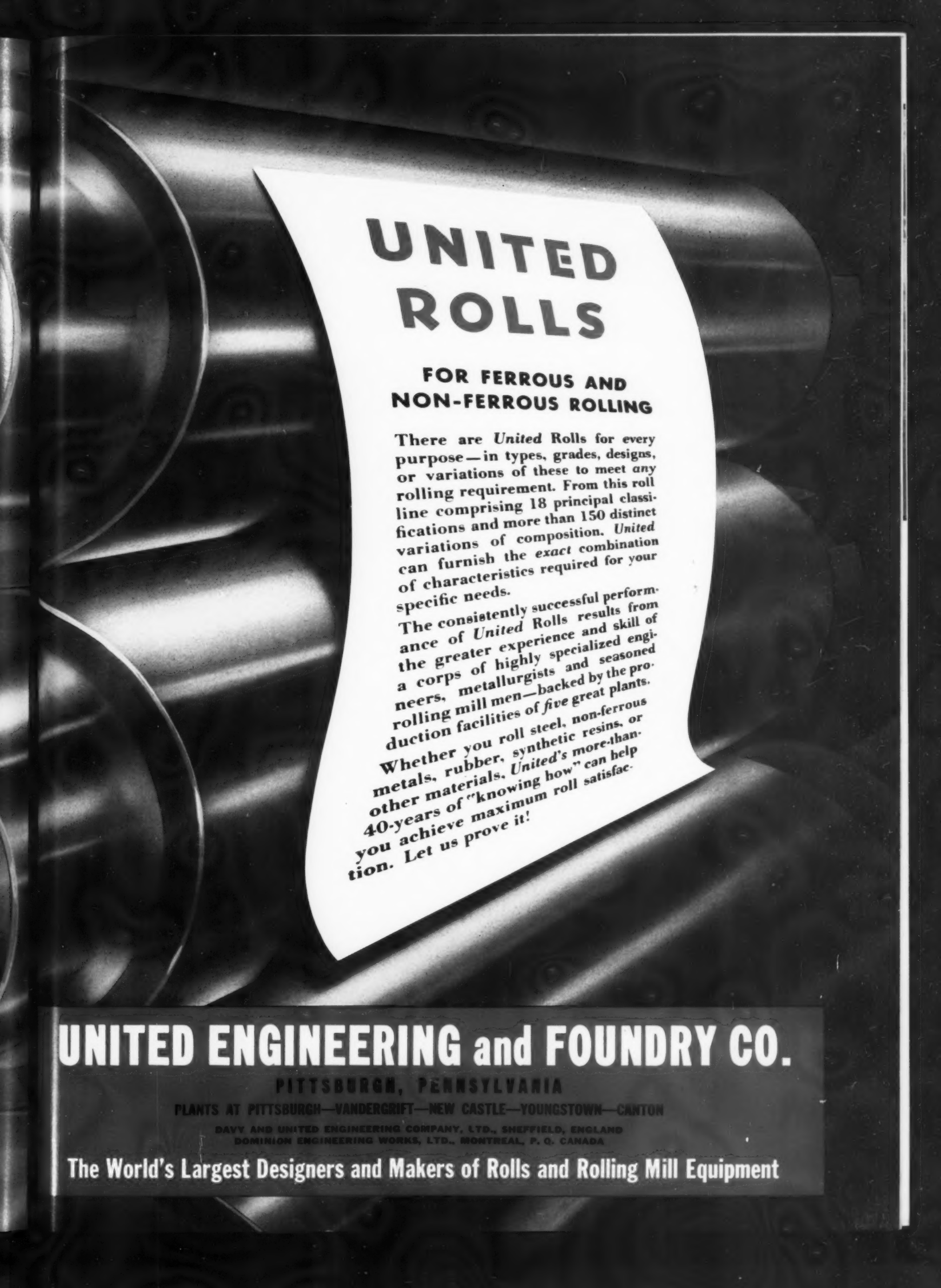
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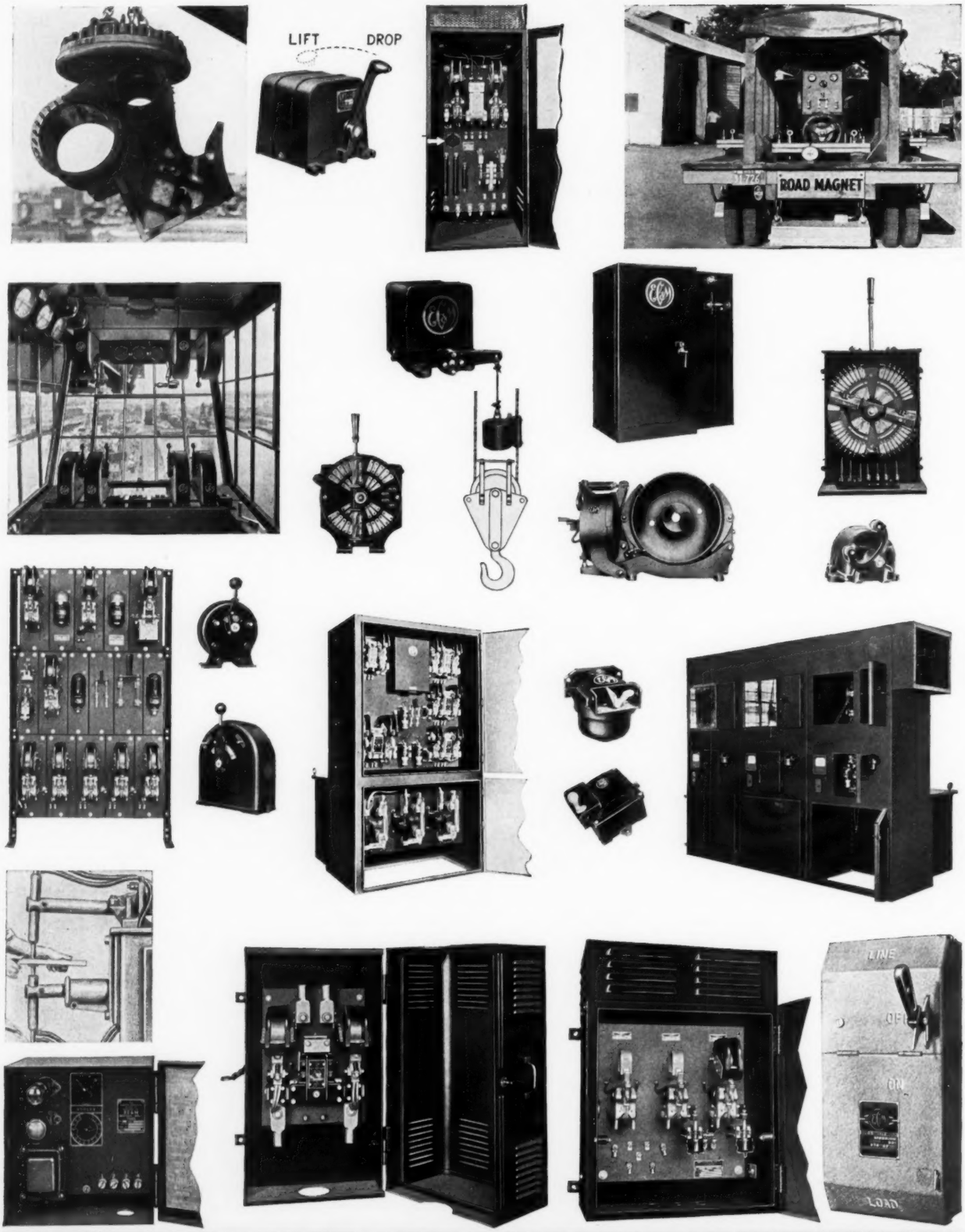

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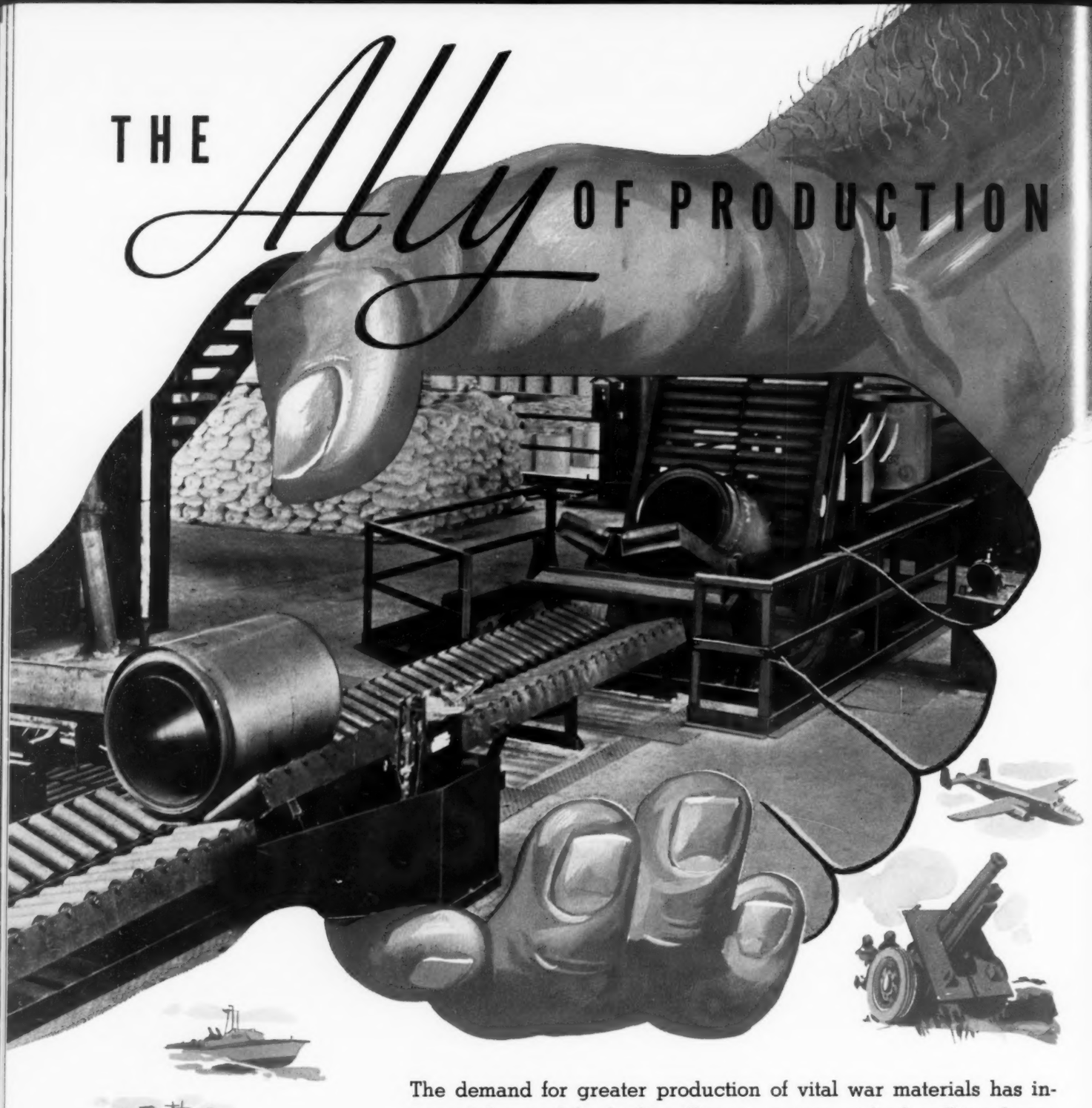

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IRON AND STEEL ENGINEER

DECEMBER • 1943
VOL. XX NO. XII

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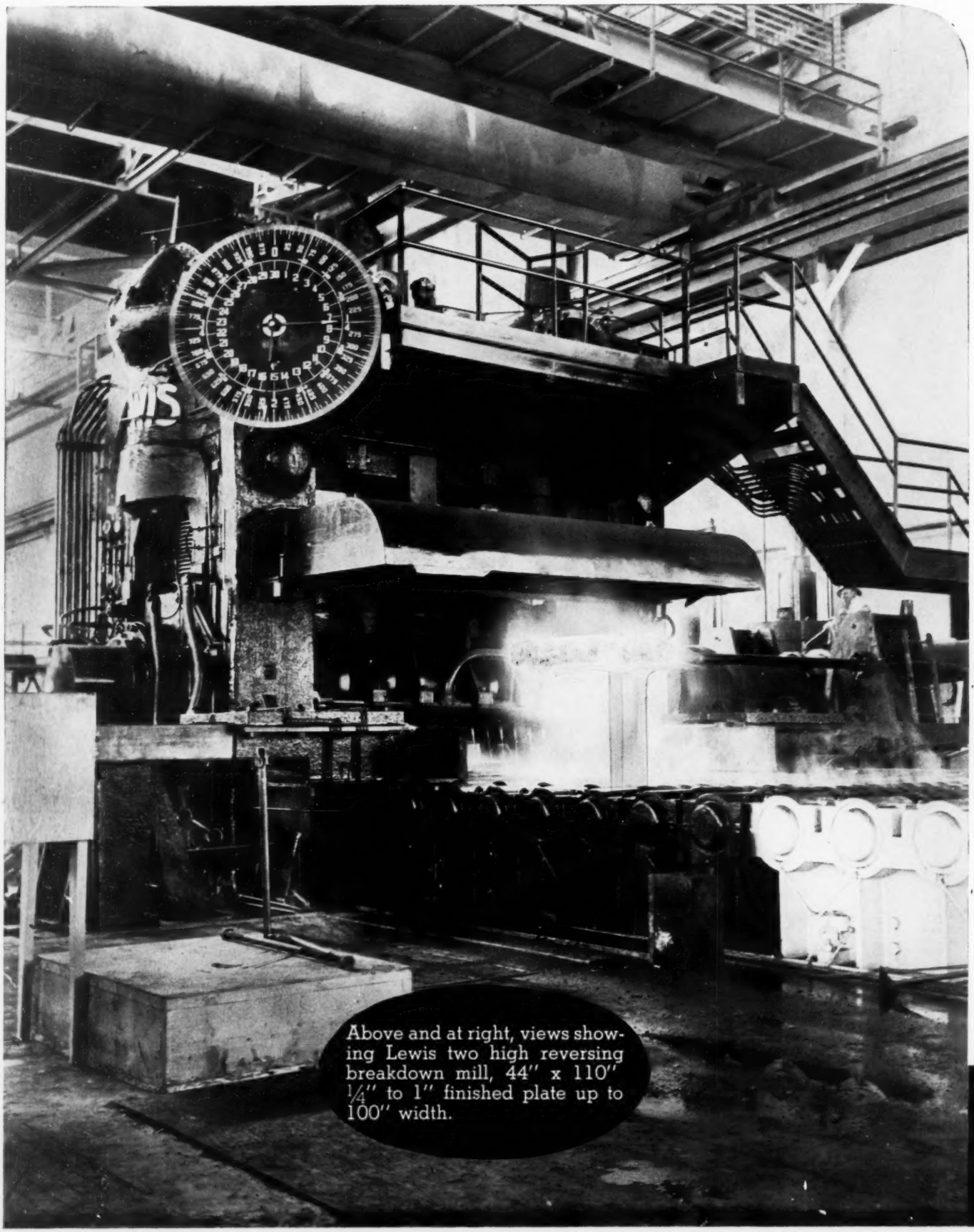

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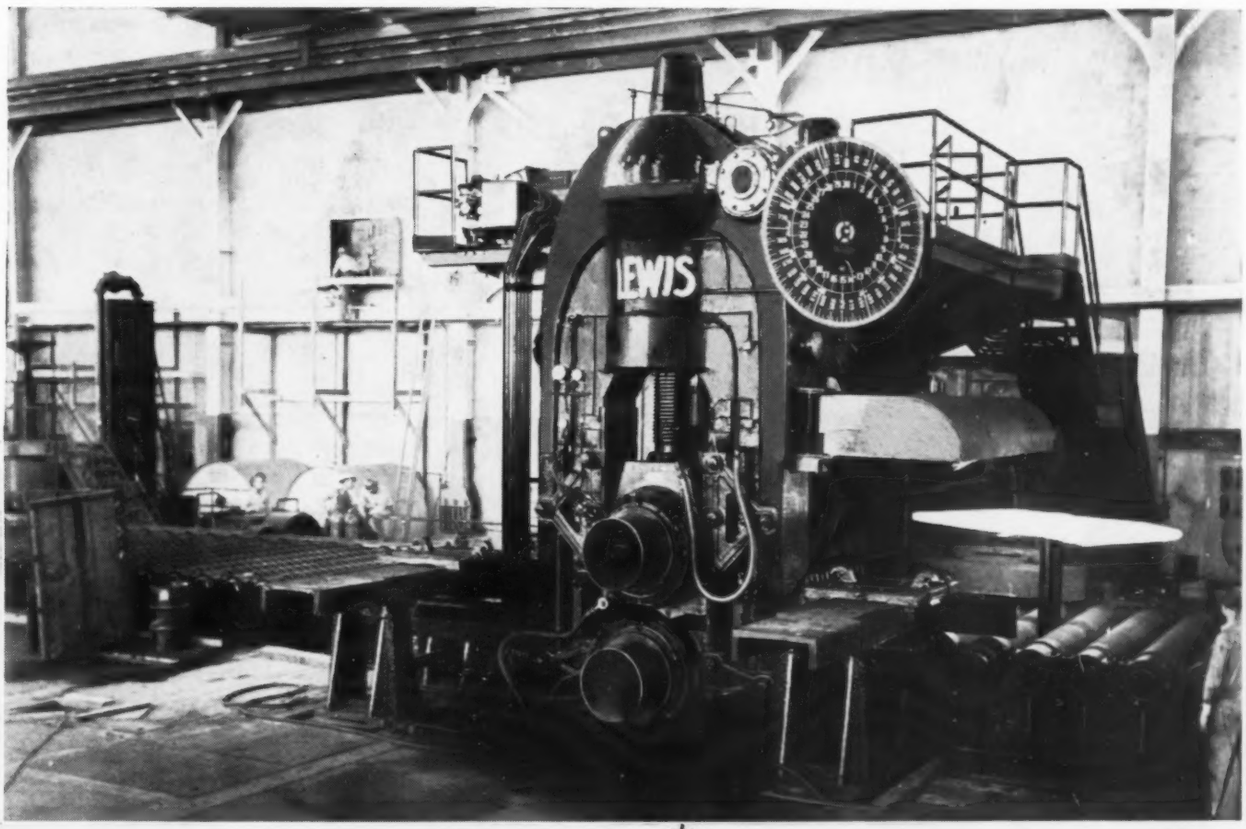

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by James Farrington

SUPERINTENDENT, ELECTRICAL DEPARTMENT

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▲ IN 1939 it became apparent that the hot strip mill at the Steubenville plant of Wheeling Steel Corporation should be modernized in the way of speed, width of strip and finish. The original strip mill, some ten years old, was slow, in comparison with the mills of today, having a maximum strip speed of about 1200 fpm. This mill was installed and placed in operation in the early part of 1929.

The mill, as originally laid out, had eleven stands, with provisions for the twelfth, in the future, and of course with the usual edgers, hot flying shears, coilers, runout tables, etc. Stands 1 and 2 were coupled together and driven by a 1500 hp synchronous motor, 150 rpm, 6600 volt; stand 3 was driven by a 900 hp, 150/300 rpm, 600 volt d-c motor; stands 4 and 5 were each driven by a 1200 hp, 250/500 rpm, 600 volt d-c motor; stand 6, driven by a 1500 hp, 220/440 rpm, 600 volt d-c motor; stand 7, driven by a 2300 hp, 200/400 rpm, 600 volt d-c motor; and stands 8, 9, 10 and 11 were each driven by a 3000 hp, 200/400 rpm, 600 volt d-c motor.

The power supply for stands 3 to 11, inclusive, were furnished by three motor generator sets, 4000 kw each.

Apparent from the start of the original mill, stands 1 and 2 motor should have been variable speed and of larger capacity, so a year later the 1500 hp synchronous motor was removed and replaced by a 4000 hp, 600 volt d-c, 300/400 rpm motor. The 900 hp motor on stand No. 3 was replaced by a 3000 hp, 200/400 rpm motor. This change contributed greatly to the increase of tonnage by nearly 25 per cent.

From 1930 to 1939 a number of other changes were made that further increased the tonnage and speed of the mill, namely, changes in the slab heating furnaces, and increasing the horsepower of the coiler motors and adding dynamic breaking to them.

In 1939 it became evident that the speed and tonnage of such a mill was slow in comparison with modern mills and that the trade demanded wider strip with an improved finish. So it was decided by the management to increase the delivery speed of the mill from 1200 to 1800 feet per minute, and to widen the mill from 60 in. to 66 in. so that these anticipated advantages could be realized.

The management also requested that steps be taken to make this change without loss of tonnage for the year and to keep the time of service the mill was not in operation to a minimum.

To the electrical department was thrown the heaviest burden. To accomplish this change it meant that the entire electrical system had to be revamped and that tests would have to be run to determine if the proposed motor horsepowers were of sufficient size and capacity so as to avoid any repetition of changes that had to be made in the original installation.

Our main electrical system was installed about the time of the hot strip mill and likewise it was somewhat out of date and of insufficient capacity to carry the proposed increase in load.

Starting at our power supply, at substation No. 7, our two transformer banks, each rated 12,500 kva,

Presented before A. I. S. E. Pittsburgh District Section Meeting, February 1, 1943.

where we step down purchased power from 66 kv to 22 kv and 6.9 kv respectively, were loaded, our switching equipment was antiquated and of the outdoor type and the interrupting ratings of the breakers were way too small. The single source of power to the motor room some 2000 ft away gave us very little assurance of continuity of service, which you all know is vital to a steel mill.

Likewise, in the motor room, our switching equipment was obsolete and of insufficient capacity. Space was limited and much new equipment had to be added. The old 600 volt d-c bus and breaker board was too small and improperly constructed for the new proposed changes.

To round out the changes, new coilers and runout table generators and control had to be added, new hydraulic pump electrical equipment installed, as well as new air conditioning equipment to replace the unsatisfactory air cleaner of the oil curtain type, hot flying shears with the delay tables and pinch rolls, mill auxiliaries and innumerable other electrical devices and control.

To do this was a tougher job than to erect an entirely new mill in a new allocated space. In fact, the installation cost would be more than double for the amount of work done.

The flood of March 17, 1936, cautioned us against the recurrence of its damaging results; therefore, we used all means to keep equipment high above flood where found possible.

Believe it or not, reflection of this flood was felt in the way of contributing to the loss of cables up to the last flood occurring January, 1943. Lead control cable was ruled out and so was cable with jute fillers and other moisture absorbing material. We have found that for flood subjected areas, a neoprene jacketed cable with non-absorbing fillers properly sealed at the ends was our best means of protection. Of course there are exceptions; to-date it has been impossible to obtain high voltage cables with neoprene jacket so we still have to resort to lead.

The first thing that had to be done was the engineering, keeping in mind flood conditions and the salvaging of all possible installed conduit, cable and electrical equipment. As stated before, tests had to be run to determine if the mill builders' specifications would be satisfactory for the job. Our test and speed cones compared very favorably with the specification except for the horsepower of the last stand. Here the mill builder recommended a 1500 hp motor. Our horsepower curves indicated that a 3000-3500 hp motor should be installed. However, against our better judgment we compromised and used a 2300 hp motor which was to be removed from old stand No. 7. Later, after the 2300 hp motor was placed in operation, the load became so great that it flashed over several times and we had to put our spare 3000 hp motor in its place.

To carry on such a project the scheduling of the equipment by the mill builders, the electrical manufacturers and ourselves had to be coordinated. This involved very close cooperation and an expeditor to see that shipments were met. Happily we can say that our plans were very little upset.

The first scheduled change in the new mill line up was the coilers. Our generators and control panels were shipped several weeks before the coilers themselves and this enabled us to install the equipment and test out the control before the main equipment arrived. The control bench-board did not arrive until four days before Christmas.

It was necessary to make some temporary setups for the new coilers, which were 250 volt d-c Ward-Leonard control, of altogether different design and method of control from the a-c variable frequency. In order to keep the old outfit in operation a new pulpit built in the form of an open horse shoe for one man operation was constructed adjacent to the old one and this new bench-board assembled and wired in place. All wires except meter leads were fastened to terminal boards. Duplicate terminal boards were installed so the pulpit could be removed quickly for floods. Several days prior to the change-over the new coilers were set up on the mill floor and ran temporarily so that all were assured that the mechanical and electrical parts worked satisfactorily. At the schedued shut down, which was the night before Christmas, the change took place. Working with all speed it took about two days and nights (54 hours, to be exact) to rip out the old equipment and place the new coilers in service.

Figure 1 — In the new layout, an edging stand is located between the first two roughers, while the third and fourth roughing stands carry integral edging rolls.

The second scheduled change was the revamping of substation No. 7 and installing part of the new loop system for the 6900 volt circuit. This involved the addition of a third 12,500 kva bank of transformers raising the total supply to 37,500 kva. In cooperation with the Ohio Power Company, a third 66 kv circuit had to be run in between the existing No. 1 and 2 circuits with its new structure, control circuits, lightning arrestors and disconnecting switches. A new complete 6900 volt indoor a-c metal-clad unit had to be installed to replace the old outdoor units and the troublesome high amperage disconnect switches. This change also included part of the addition of the 6900 volt loop system. A third 22 kv transformer circuit and

its breaker were installed, and the four old breakers modernized and raised above flood level.

New transmission lines and tower had to be installed with the necessary control cables to take care of the remote control, demand metering, signal and position lights and relay circuits. This too had its hazards, with temporarily supported high tension lines and control cables. It was necessary, for short durations, to by-pass oil circuit breakers and relay protection.

In making many of the required changes we took advantage of the mill shut-down periods which occurred every ten days or thereabouts and lasted for 8 to 10 hours; however at no one time were we able to have a complete outage of power as it was of vital necessity that power be supplied to the water works, blast furnaces, open hearth and coke works at all times.

The third scheduled change was the installation of substation No. 9 and completion of the 6900 volt loop circuit. This portion of the work, although mostly new construction throughout, had its difficulties. The tower used for terminating the lines from substation No. 7, and also the motor room, was already well burdened with wires. It supported two 22 kv circuits to the coke works; two 6900 volt circuits to substation No. 8; two 2200 volt circuits to No. 1 power house, besides the miscellaneous control cable, overhead ground wire and lightning arrestor equipment. Working in such a tower where only part of the circuit could be "killed" required that a safety man and safety equipment be used to the utmost. The linemen working in this tower really had to be expert contortionists.

With the installation of this portion of the loop circuit we were able to remove No. 8 substation circuits out of substation No. 7 and change it over to substation No. 9, thus allowing us to remove another part of the temporarily supported cables at substation No. 7.

As a side issue during this phase of the change-over, No. 1 tandem mill was modernized by the installation of a 6000 kw motor generator set, new drive motors and control, which, in reality was a new mill as far as the electrical end was concerned. The switchgear for this equipment was incorporated in with No. 9 substation's switching equipment.

With the completion of substation No. 9, the fourth scheduled change was in the motor room which proved to be the most laborious of them all. Maintaining rolling schedules, guarding against power failure, the safety of life and property had to be constantly watched and checked. To change over the rolling mill equipment and line up the new switchgear with the old was a tedious job, and much checking and double checking had to be done so that accidents and mishaps would not occur. Oil circuit breakers were rolled out on the floor and lines run to them over the floor like lamp cord.

As related before, space in the motor room was limited and to make room for the new equipment it was necessary to remove a 25,000 hp uniflow four cylinder engine. The engine was located right in the middle of the motor room, lying between stands 4 and 5, and was used to drive the old 19 in. bar mill. Its foundations were massive, some 30 ft below the floor, and around the edge of the foundation were hundreds of conduit carrying power and control to seven of the stand motors and the three 4000 kw motor generator sets. This equipment and its foundation had to be taken out while the mill was on scheduled rolling operation.

Figure 2 — View showing the revamped finishing train, now composed of a scale breaker and six four-high mill stands.

Foundations had to be made for the new 4000 kw, 600 volt motor generator set and the lower steel generator gallery was extended approximately 70 ft and all motor generator sets erected; the upper steel 600 volt d-c switch board gallery was also extended 70 ft and erected while the mill was in operation.

The 2,000,000 cir mil lead-covered cables were disconnected from the switch board and one section of conduit at a time was unscrewed and slid over the lead cable, which was then reconnected to the switch board. The 4 in. conduit was laid, two in a row, 16 rows high and 60 ft long. Protection of the stand motors was a problem, to guard against flying particles of dust and grit. At first a house was built over old No. 10 stand motor foundation to keep the dirt from the running motors, but this did not work so well. as it delayed the work, and it was finally discarded. To guard against this dust, streams of water were played on the concrete where the chipping and drilling was being done, and barrier curtains were put around the adjacent motors. This worked out fairly well. Drilling and chipping away of the foundation of the engine was a tedious job, so finally we resorted to blasting. As soon as they were ready to blast, barricades were set up before the motors and heavy rope blankets were placed over that portion of the foundation to be blasted away. With all the added precaution, pieces of concrete did manage to fly and bull's eyes were scored on various meters, which were changed.

The work in the motor room was carried on by three

separate crews; one crew worked on the a-c switchgear and one on the d-c switchgear and one on mechanical work in the hot strip end of the motor room. All crews worked to prepare for a quick change-over to new equipment so that during the eight to ten hours shutdown period this could be accomplished. Sometimes these preparations showed very costly labor, doing ten hours work to get two hours work accomplished. This particularly held true when trying to replace the old 600 volt d-c breaker board and bus with one of new and modern design. This part of work was finally abandoned until the shut down occurred.

A brief description of the shifting of motors may be of interest. As pointed out before, the original mill had eleven stands with provision for a twelfth.

The new mill was to have only 10 stands with stand No. 10 located on old future No. 12 foundation.

Motors on stands No. 1, 2 and 3 were not changed. The 3000 hp motors on old No. 8 and 9 stands, which afterwards became new No. 6 and 7, remained on their foundations. The 3000 hp motors on old stands No. 10 and 11 were moved to drive new stands No. 4 and 5. Old stands 4 and 5 were abandoned and the room between the stands used to accommodate the hot flying shears, delay tables and pinch rolls. The 1200 hp motor that was on stand No. 4 was transferred to No. 1 edger lying between stands No. 1 and 2 and located in a pit out under the mill floor. The old drive on stand No. 6, a 1500 hp motor, was removed and the 3000 hp motor from old stand No. 10 was placed on its foundation, afterward known as new stand No. 4. Old No. 7 stand motor, 2300 hp, was moved to the old future No. 12 stand foundation and known as new No. 10 stand. The old No. 11 stand motor, 3000 hp, was moved to old No. 7 stand motor foundation and called new No. 5 stand. Old stands No. 10 and 11, now known as new No. 8 and 9 stands, were equipped with two new 4000 hp motors.

From the above "checker playing," keeping the mill running at the same time required quite a little study. First, we started out with a spare 3000 hp motor; it had two rows of bolt holes in the coupling to match with either 12 in. or 14 in. couplings on stub shaft, and two filler plates, one 1 in. thick and one 2 in. thick.

We could connect the 3000 hp coupling to any one of the stub shafts leading to the mill reduction gears or stands, whichever the case may have been. This motor likewise had special liners for the field frame supports and bearing pedestals, all to be interchangeable with the new line-up, and thus was a spare for all size motors on the mill. On the new No. 10 stand we purchased a new bed plate and installed special liners under the 2300 hp motor, so that when we removed it, ample room would be provided for our spare 3000 hp motor. As pointed out before, it was a good thing that we made this last move for our tests showed that new No. 10 stand should be equipped with a 3000-3500 hp motor, and later we had to remove the 2300 hp motor and use our spare 3000 hp unit. The motor bases on No. 9 and 10 stands were only 2 in. apart.

We next made up a special lifting rig for the motors so that, in changing the motors around, it would not require the long tedious job of completely disassembling the motor. With this rig we could lift the armature and field frame as one unit without disturbing the brushholders.

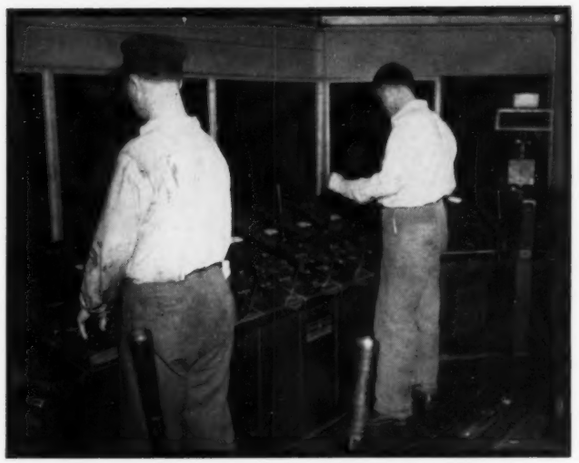


Figure 3 — This speed and looper pulpit, built in the shape of a horseshoe, controls the mill and tables from No. 1 stand through to No. 10 stand.

The mechanical crew did a wonderful job of removing motors from their structural steel bases, and bases from the foundations. In three cases motors and bases were removed, foundations changed, new steel bases put in, motor placed on base plate and lined up, base grouted and motor put into service in 48 hours while motors on either side were in operation.

Two steel frames, 8 ft high, were made to support both the spare motor and the motor removed from the stands. It required from 3½ to 4 hours to remove a motor from its base after it had stopped rotating.

Having these means available, a stand at a time was "dummied" and during the 10-day periods between shutdowns, foundations were altered, new bed plates grouted in, cable and control connected in so that on the next shutdown period this stand was ready to run, and a new stand was dummied ready for the same procedure.

In changes like these new conduit had to be placed under old conduit on racks and as the new ones were cut in service, the old conduit and cable were removed. Junction boxes and manholes had to be constructed with the thought in mind of salvaging as much of the installed cable as possible, trying to keep the installation cost to within a reasonable figure.

When it came to installing the new 95 ft d-c breaker board and bus, we had quite a problem. The new panels were much wider than the old ones and in order to accomplish as much as possible before the one week scheduled shutdown to complete the change-over, we started to set up the new board, working from both ends toward the middle. In setting up such a long breaker panel, it is rather tricky to hold to dimensions. We decided to allow one inch space for any variation in the board. After we set up a few boards, we found that too much time was lost at shutdown periods, and we finally abandoned the board installation until the scheduled one week shutdown time occurred. When we

finally did install the board we found that it was not necessary to have left the one inch space as the board had been very accurately made.

The new 600 volt d-c circuit breaker switchboard was longer than the old one, making it necessary to reroute and lengthen in some cases the 2,000,000 cir mil cables from motors to switchboard. There was no room to install the new control cables along side of the old ones, so a new steel rectangular trough was installed back of the switchboard on the floor and all new cables were placed inside of same.

During the razing of the engine foundation and the erection of the new 4000 kw motor generator foundation, it was necessary to bridge the 75 ft gap with a high elevated wooden bridge back of the stand motors. From this high elevated walkway, wooden steps led off down to wooden planks around the stand motors so that the usual inspections of the motors could be made. Several days during this construction it was necessary to have an operating force on the north "plaza" for safety, for no real accessible means was available in case of trouble. Fire hazard gave us a great deal of concern and the wooden structures were constantly watched.

In changing over to the a-c duplex control cubicle in the motor room, work was carried out similar to that at substation No. 7, only on a larger scale. Many new features were included such as automatic power factor correction equipment to control the power factor of the entire purchased power for the plant, and the remote demand indicating and alarm system so that control of the peak demand may be held to within prescribed limits.

The old a-c switchboard containing the relays, controls, meters and indicating lights for the 66 in. 22 and 6.9 kv circuits had to be moved to install the new duplex control cubicles. This was accomplished by first splicing sufficient loops in each wire to permit cutting the original wiring and moving the whole board out about six feet. The new duplex cubicles were then put in place and the process of transferring the old wires from the old board to the new duplex cubicle began. This was a very trying and nerve racking job, as the opening of any one of the many wires would mean the shutting down of one or more machines, or the dropping of our entire load, as we control the power company's 66 kv oil breakers from the motor room.

During these changes in the motor room a fourth crew was kept busy out in the mill proper, rerouting the conduit to care for widening of the stands, the changes to the mill auxiliaries and rewiring of the enlarged oil cellar.

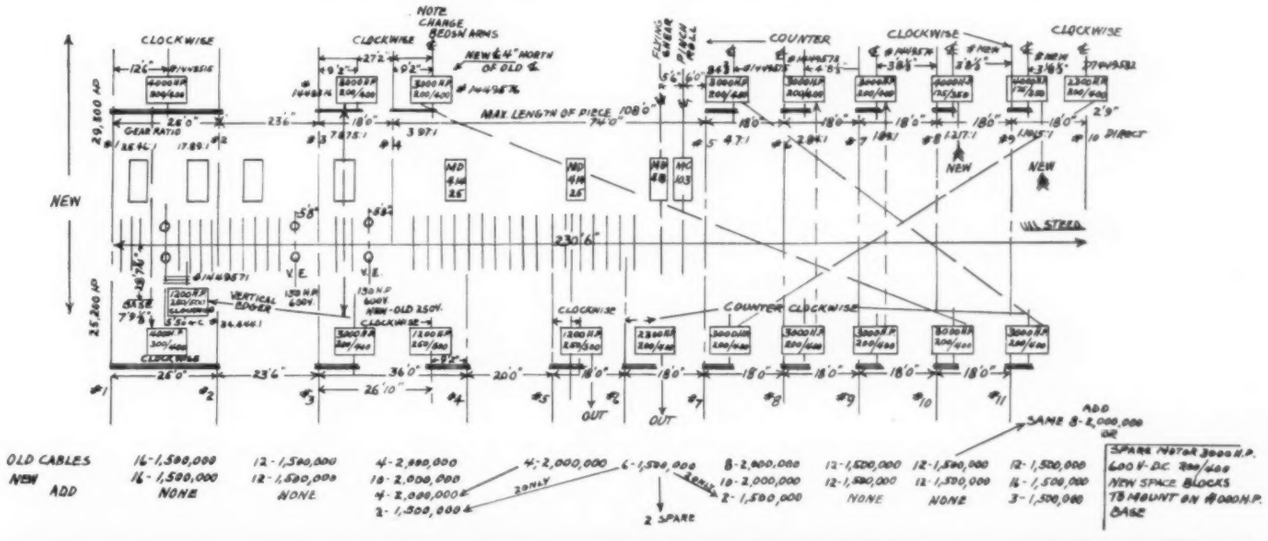
The installation of the hot flying shears, delay table and pinch rolls presented its problem, too. It so happened that the crop-end pit had to be located right at the junction point of the conduit and cables leading to the screwdowns, loopers and other auxiliaries. Rerouting of cables and temporary wiring was done while the mill was in operation. The workmen accomplished this under the floor, wearing rubber boots, raincoats and hats, with the usual water, grease and oil spraying over them. The pulpit controlling the hot flying shears, delay table and pinch rolls was made removable in 30 min by the use of terminal boards.

Sandwiched in with these changes, it was necessary to follow along and make the necessary changes in the speed operators pulpit. A new pulpit was constructed just north of the old one and during the changes part of the operating crew would be in the old pulpit and part in the new.

At the time of the scheduled one week shutdown period we felt quite relieved to feel that so much work had been done that we could easily do our remaining work within the allocated time. It so happened that we had the electrical portion of the work ready in 7 days. The mill shutdown at 7:00 A. M. October 23, 1940, and started up at 2:30 P. M., October 31, 1940, being down 8 days, 7½ hours.

As pointed out before, we added many new devices most essential for good operating practices.

Figure 4 — Sketch showing old and new arrangement of mill and drive motors.



One of the so-called big "little jobs" was to carry out systematically the proper phase position of the lines and circuits not only for the 22,000 and 6900 volt circuits, but also the 2200 volt circuits, and we still are carrying this out further where new installations are made or old ones revamped on 220 volt a-c circuits.

Prior to this 1940 change-over, no particular attention was paid to phase position of the lines and circuits. Anyone who is familiar with a job of this kind knows what a big "little job" this could turn out to be. Another step we took was to apply a color code to the various potential circuits. We painted the pot-head bases, insulator caps, etc., so one that was not entirely familiar with our system could distinguish the 6900 volt circuit from the 2200 or 22,000 volt lines by merely glancing at color markings on the insulator caps and pot-head bases. Likewise, in the mimic bus layout on the load dispatcher control cubicles, color coding was used to denote the various potentials of the circuits.

We might add that we removed the famous choke coils from our transmission lines at this time. These were held in high esteem by one of the leading electrical manufacturers when the original installation was made. In fact, the starting of the original installation was held up three days until these valuable gadgets were received by motor express from their factory. The only real purpose they served was to make a very expensive roosting place for birds. Now they rest 10 ft under the sod serving as a ground connection.

One very interesting part of the installation was the new section of our 6900 volt line. This line was constructed of 795,000 cir mil A.C.S.R. 54 aluminum strands, 7 steel strands. For current carrying capacity we used two cables per phase per circuit. These two cables being of the same potential were spaced only 11 inches apart on separate insulators. After the lines were up several weeks, we happened to be carrying the total 6900 volt power over this section of the loop circuit, the other section being cut out. Returning from lunch one noon we walked over near these lines and noticed that the cables that were spaced 11 inches apart were swinging and actually touching each other and would roll together for a distance of 40 to 50 ft, then unroll, no immediate damage being done for they were of like potential. Checking further we noticed that the pulsations of this rolling action followed along very closely with ingot passes through the 45 in. blooming mill. Having fear that in due time the soft aluminum wire would become damaged, we purchased some special aluminum clamps and bolted these conductors together at intervals of fifty feet. Noticing what happened to the aluminum lines we transferred the power to the other section of the loop circuit which was of similar construction except the cable was 500,000 cir mil stranded copper. Here we did not experience similar results. It appears that this swinging action was due primarily to the iron core and heavy currents.

Summing up our achievements we felt that Dame Fortune was most kind to us as we experienced no mechanical or electrical damages, no accidental outage of power, or injuries sustained to the men on this rather hazardous modernization program of the mill. Our men are to be congratulated on the fine job they rendered, safety to life being the paramount issue.

DISCUSSION

PRESENTED BY

T. R. MOXLEY, General Master Mechanic, Wheeling Steel Corporation, Steubenville, Ohio

F. H. DYKE, Superintendent, Blooming, Bar and Hot Strip Mills, Wheeling Steel Corporation, Steubenville, Ohio

T. R. MOXLEY: The first step taken in connection with the above job was the installation of two new coilers which was started on the morning of December 25, 1939. It required 54 hours to remove the old coilers and install the new units. This was possible due to the new coilers having been designed to fit the old base plates, thereby eliminating the necessity of foundation work. Rolls in the new coilers are 60 in. long, as compared to 54 in. in the old coilers.

In the year 1940, during roll change and repair periods the work of changing the hot strip mill over from 60 in. to 66 in. capacity was completed. First, No. 4 stand was taken out and a temporary motor driven roller table was installed. The foundations for the pinion drive and stand proper were put in while the mill was operating, except that portion directly in the roll train line which was done on repair periods. The old gear drive housing and pinion housings were used and these, of course, were set while the mill was operating. A complete new set of gears was installed in the gear drive and these were "run-in" without interruption to mill operation. It was necessary to remove old No. 4 stand foundation in order to continue the scale wash throughout the mill under the tables.

No. 5 stand was then taken out and the old foundation removed. Next, No. 6 stand was removed and installed as new No. 10 stand, this being the finishing stand of the hot strip mill roll train. The foundation for this was put in during the original installation of the mill. Old foundations for No. 5 and 6 stands were taken out and new foundations installed for the rotary crop shear which is now located on the entering side of present No. 5 stand, formerly old No. 7 stand. The driving mechanism for this crop shear was installed while the mill was operating.

In order to accommodate 66 in. body back-up rolls, it was necessary to remodel the bearing seals in the rolls for all of the back-up roll bearings. This was done by cutting off a portion of the back-up roll chock and inserting a filler ring which would extend into a counterbore on each end of the back-up roll.

In order that the entering guides to all of the four-high stands could be adjusted out to the maximum width desired, the crossheads and nuts which operate these guides had to be shortened 1½ in. on each side.

On No. 3 and 4 stands, which were equipped with vertical rolls, the housings of these vertical rolls had to be machined in the ends, also new roll chocks provided that would permit widening out 1½ in. on each end. This was done during repair day periods as a spare

housing was available and new nuts provided. During this time the foundation work was completed for the installation of a new vertical mill, located between No. 1 and 2 stands. The side guides on all roller tables from the entering table of the slabbing mill on through to the delivery table of No. 4 stand in the hot strip mill were set farther apart. This was done by cutting off the side guide supports, moving them out 1½ in. on each side and welding them back to the same brackets, there being sufficient metal in these brackets and supports to permit this to be done.

The delivery tables from No. 10 stand to the coilers, and from this point down the entire length of the cooling bed, were changed from lineshaft drive to individually motor driven table rollers. This work was also done during repair periods. Templates were made and a radial drill press, mounted on a suitable table was taken to the mill, new holes drilled in the table housings and a section of this table changed over each repair period until the whole job was completed. In performing this work, it was necessary that a definite amount of this work be done during each period in order to be able to remove a section of the lineshaft to the couplings, and still continue to use a portion of the lineshaft driven table and a portion of the individually motor driven table rolls. During this period all of the housings of the four-high mills were taken out and returned to the manufacturer. The housings were remachined and new window liners installed. This was necessary due to previous wear in the housing windows. A method was devised whereby a complete set of housings, fit up with screwdown drives, separators, etc., could be removed from the mill in one lift. The repaired housings to be set in were fit up in the mill on I-beams, and repaired housings placed back in the roll train with one lift. This was done during repair periods.

In October, 1940, new No. 1 and 2 stands (which were two-high mills) were removed, longer spreaders installed in the bottom and a filler installed in the top together with longer drive shaft for operating the screwdown. This work necessitated cutting off spindles to compensate for one-half the amount the housings were extended, viz., 1½ in. In order that the entering guides could be extended entering No. 1 stand, it was necessary to remove 1 in. of metal from the housings on the entering side of No. 1 stand to permit these guides to be extended 1½ in. on each side of the center line.

New gears were installed in the gear drives of No. 6, 8 and 9 stands, and the gears in old No. 9 stand were moved back to No. 7. This was done in order to increase the speed.

In the 45 in. slabbing mill, in order to permit the vertical rolls to be adjusted farther apart and thus accommodate 66 in. ingots, it was necessary to remove 1½ in. of metal from each side of the main mill housings. This was done by the use of scarfing torches, commonly used for scarfing slabs; also the main drive bearings which drive the vertical rolls were cut off proportionately. The knife seats of the slab shear were cut out 1½ in. on each end in order to permit installation of 66 in. knives; also, during the change-over, a complete hydraulic roll balance was installed for supporting the top back-up and work rolls in the four-high stands of the hot strip mill.

F. H. DYKE: In commenting on Mr. Farrington's paper we will not touch at all on the electrical end except in one or two minor details as he has covered this feature exceptionally well.

In the change over of this mill there were many operating features which took very careful planning. The old mill was an 11 stand mill put in a small building with the following centers between stands: No. 1 and 2, 25 ft; No. 2 and 3, 23 ft, 6 in.; No. 3 and 4, 36 ft; No. 4 and 5, 20 ft; No. 5 and 6, 18 ft, and 18 ft centers throughout the balance of the mill. You will note that with these centers we had practically an eight-stand finishing train, and no space between the roughing and finishing. The vertical mills were on No. 3, 4 and 5 stands, and consequently it was very difficult to control width.

Before starting on the change-over program we planned the mill to have the same centers between No. 1 and 2, and between No. 2 and 3; 18 feet between No. 3 and 4, and 74 feet between the center line of No. 4 and the center line of No. 5 mill, our first new finishing stand. This space between finishing and roughing was not all open as in front of No. 5 we were to install a two-high pinch roll scale breaker and a crop shear. We were also to install an edging mill between No. 1 and 2 stands with vertical edgers remaining on No. 3 and 4 stands.

The first move was to figure out the location for a speed operator's pulpit. This had to be spaced so that it did not interfere with the view from the old pulpit and in a place so that all the new conduit and control could be installed before the mill was shut down for the final change-over. Included in this feature was the speed pupit built in the form of a wide open horse shoe with a looper operator located at the left of the speed operator. This was done so that two men could have ample vision to handle the mill and tables from No. 1 through No. 10 stand, and so that the looper could handle the controls of the roughing mills in an emergency.

The oil cellar which contained our oil tanks, pumps and piping in the old mill was located between No. 3 and 4 stands, just where the new foundation for No. 4 mill and drive was to be installed. All of this installation had to be relocated. Our first step on the mill was to remove No. 4 stand, the gap being bridged by a temporary motor-driven table. This gave us a ten stand mill. Excavation was started at once for new foundations for No. 4 and foundations for new oil cellar. No. 10 and 11 stands were dummied one at a time while work on shaping and installing new motor foundations in the motor room was carried out. We worked a good while with a nine-stand mill, and with careful heating, drafting and regulation of slab size, we could roll down to and including .060 in. gauge. At the same time this work was going on, temporary cables were run to all motors, tables and screwdowns on No. 1 and 2 stands, and these stands were undermined and jacked up while foundations were being installed for the new edging mill and drive between No. 1 and 2. More of this work was done under the cover of a plank floor and duck boards as we have a very limited floor space and practically all of this space was necessary for successful operation. After the changes to the motor foundations

(*Please turn to page 81*)

Bar Mills AND BAR MILL Roll Design

. . . . the author traces the history and progress of the bar mill, and sets forth typical modern practices . . . .

by Ross E. Beynon

SUPERINTENDENT, ROLL DEPARTMENT

CARNEGIE-ILLINOIS STEEL CORPORATION

SOUTH CHICAGO, ILLINOIS

▲ BAR mills are the most common type of rolling mills and are also among the oldest, their introduction in the industry dating back to the period around 1782, according to some authorities. Early bar mills were two-high units, primitive in design, and for many years very little improvement was made in their design. With the introduction of the three-high mill and the four-high double-duo mill, however, real improvement began in bar mill design.

The first simple layouts, used for rolling iron, remained practically the same, except for minor details, until the advent of the steel billet. This inaugurated a new era in the bar mill industry and mill layouts had to be changed to meet the new conditions. As a result, we have seen the gradual evolution from the old, slow, hand-operated bar mills to the modern type, high-tonnage mills which meet present day needs.

Bar mill design has progressed more rapidly in the United States than in any other country. This is due in part to the high wages paid mill hands in this country, which encouraged manufacturers to develop mills capable of rolling large tonnages per unit of time, thus reducing manpower cost per ton.

It has been evident from the first that the tonnage obtained from a mill depended largely upon the delivery speed and efficiency of the finishing stand. Mill efficiency increased as the length of the bars increased and as their speed of delivery increased. Likewise, as the time interval between bars was reduced, the tonnage of the mill was increased.

Another factor that has stimulated progress in mill design tending toward the reduction or elimination of hand operation is the fact that roll speeds are limited in hand-operated mills by the inability of the men to catch bars leaving the rolls at speeds greater than 1600 feet per minute. Even this speed can only be attained on bars of small cross section. Large bars must be rolled slowly, as they are too heavy and stiff to be handled at high speed. Mechanical devices for eliminating hand work have played a large part in reducing rolling costs.

Since the first mill was started, many advances in design have appeared and with each improvement the speed and tonnage of the mill has increased. The most successful designs will be discussed briefly in chronological order.

EARLY BAR MILLS

The first bar mills built in this country were three or four-stand mills, all rolls being driven by the same engine. The first stand was a three-high rougher. Next in line was a three-high set, called strand rolls. This set was followed by a two or three-high set, sometimes called the leader stand, and the last stand was a two-high finishing mill. Drawing 1 illustrates this early four-stand type of bar mill.

This mill was served by a flat hearth furnace, the early units being coal fired. The stock usually consisted of hammered blooms or iron piles, although in some

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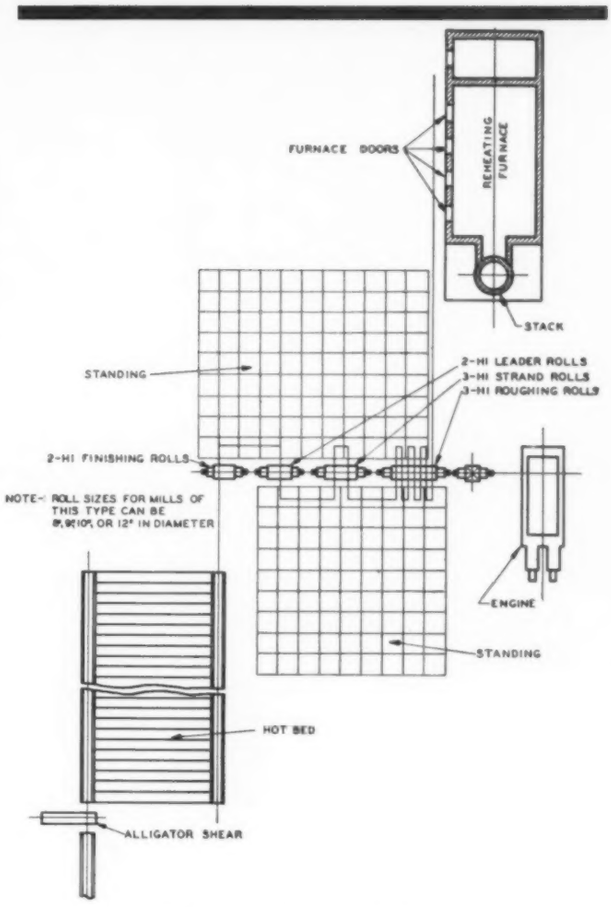
instances billets of puddle iron were used. Blooms, piles, or billets were transferred from the furnace to the roughing stand by tongs suspended on a trolley, the tongman running them down to the mill by hand.

The iron piles were delivered to the rougher at a welding heat and rolled back and forth through the mill. Seven passes were usually made, each pass reducing the pile. Tongmen then transferred the roughed pile to the strand unit where it was given from two to five passes as necessary. Following this rolling the bar was transferred to the leader and finishing stands. After leaving the finishing stand the bars were pulled across a short hot bed consisting of rails or gratings, a man at each end of the bar being able to handle the product. An alligator shear at the end of the hot bed cut the bars to length.

Unless some steel was included in the scrap used in making up the pile, the pile was thoroughly welded in the roughing passes. Steel usually showed up in the form of a scab, which could often be knocked loose from the bar before finishing.

The earlier mills had only one furnace and it was customary to roll the furnace charge as rapidly as possible, the roll hands and mill standing idle until the next furnace load could be charged and heated. Seven heats were considered as a day's work, 10 to 15 tons being rolled per turn. Later mills had two or three



Drawing 1 — Four stand bar mill.

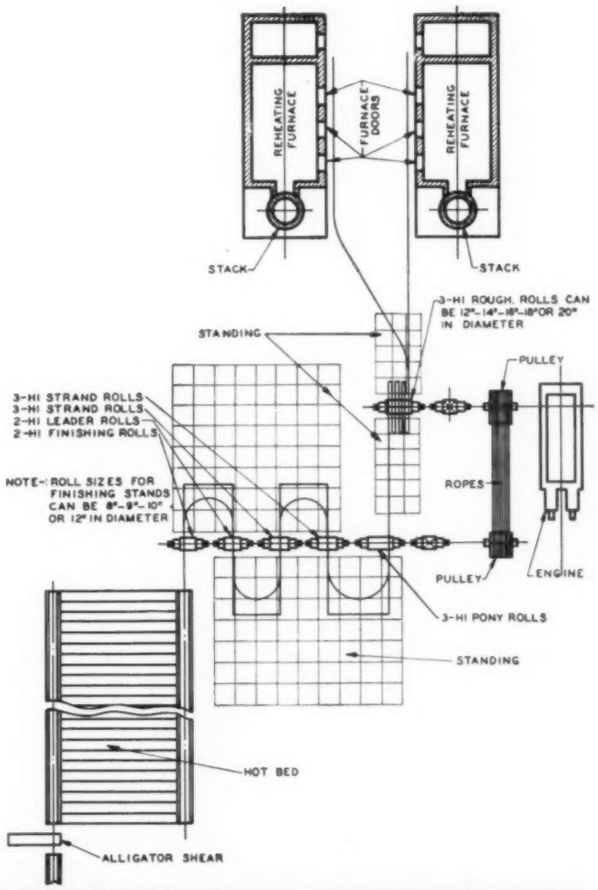
furnaces, thus keeping the mill and crew busy all the time and making it possible to roll from 25 to 50 tons per turn.

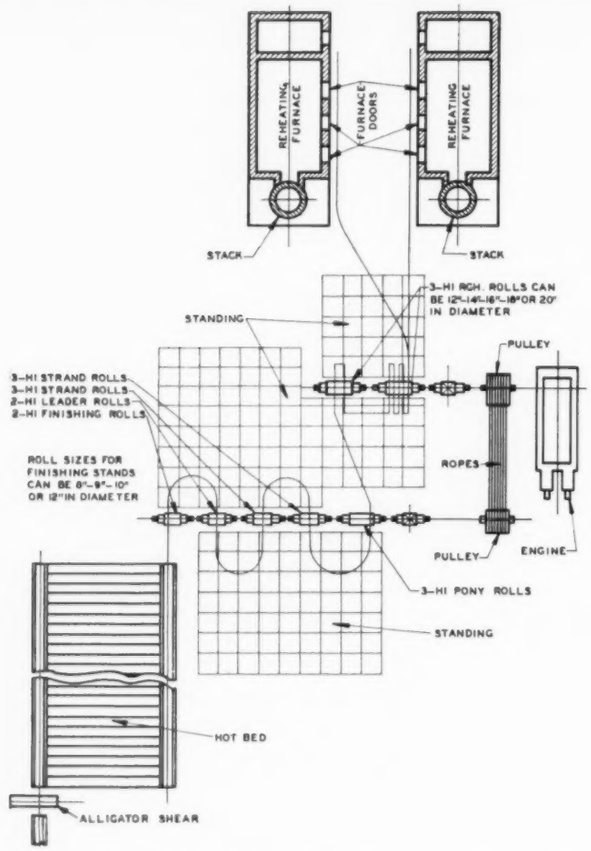
One of the principal disadvantages of the early mills was their slow delivery speed. This was necessary because the men working on the roughing stand had to catch the bar with tongs on each end and re-enter the piece by pushing it forward into the proper pass. If the bar came out too fast, it would push the men off their feet as they caught it with their tongs. More time was available at the strand, leader, and finishing passes. Here the men caught the end of the bar as it was completing the pass and they were able to catch and re-enter the bar with little difficulty.

Drawing 2 illustrates the next development, which consisted of installing a separate roughing unit ahead of the main mill. Roughing could thus be done at slow speed, while the finishing stands could be operated at a considerably higher speed. This resulted in longer bars being rolled at higher speed, with a consequent increase in tonnage.

It was discovered about this time that the smaller bars could be looped from one stand to another by catching the front end of the bar as it came out of one pass and turning it in a half circle to re-enter the bar into the next pass in the next set of rolls. This reduced the time required to roll a bar and further increase the tonnage.

Drawing 2 — Five stand bar mill with separate rougher.





Drawing 3 — Five stand bar mill with two-stand separate rougher.

Drawing 3 illustrates a still more advanced type of mill. In this design two stands of rolls in line are used in the roughing train. The advantage of this scheme was that the roughing passes could be divided between two stands, with the result that more bars could be produced.

STOCK

Most of the stock used in the early mills consisted of iron piles. These piles were made up in various ways, Drawing 4 showing the most commonly used types. The most frequently used type, or box pile, had flat iron sides, bottom and top, the center consisting of short pieces of cut scrap. The bundle was tied together by two or more wire wrappings which served to hold the pile intact until it was heated enough to stick together. Another type of pile was made by wiring together pieces of round and square bars cut to pile length, usually with a flat bar serving as a base. This was called a fagot pile, from its likeness to the bundles of wooden sticks used in olden days for firewood. Another pile consisted of iron rails piled together. Still another was made by piling up a number of iron flats, usually made of puddle iron. Another source of material was old railroad axles, either iron or steel. These piles were brought to welding heat in the furnaces and after a few passes in the roughing rolls the assemblies were thoroughly welded together into a relatively homogeneous billet from which the final bar was rolled.

Puddle iron was an important source of bar stock in the early days of the rolling industry. In this process, a charge of cold pig iron is melted in a small basic furnace lined with iron ore. Carbon, manganese, silicon, and most of the phosphorous and sulphur are oxidized and converted into a fluid slag during the heating process. Particles of pure iron separate themselves from the mass and are not melted but remain in a pasty state, coated with cinder. The puddler forms these particles into a ball, using an iron bar or paddle. The ball is removed from the furnace by tongs attached to a trolley and taken to a squeezer. Here the pasty mass is worked around a corrugated wheel which squeezes out the cinder and finally shapes the mass into a rough round bloom suitable for rolling. After squeezing the rough bloom is sent through a roughing roll train called a puddle bar mill and rolled into either a flat or square billet. Drawing 5 shows a typical puddle bar mill layout.

Flats from such a mill were cut and assembled into piles for reheating and rolling in the finishing bar mills previously described. When this product was rolled into flats or billets which were again heated and re-rolled before going into finished products, the process was called double refining.

Instead of using pig iron, some puddle type furnaces were charged with cut up scrap, the metal being worked into a ball which was processed as previously described. This method of treatment was called busheling. Still another practice was to throw turnings into the furnace and puddle them into balls. This was called swarfing. In both of these methods, iron and steel scrap were used indiscriminately.

Drawing 4 — Iron piles used in bar mills.

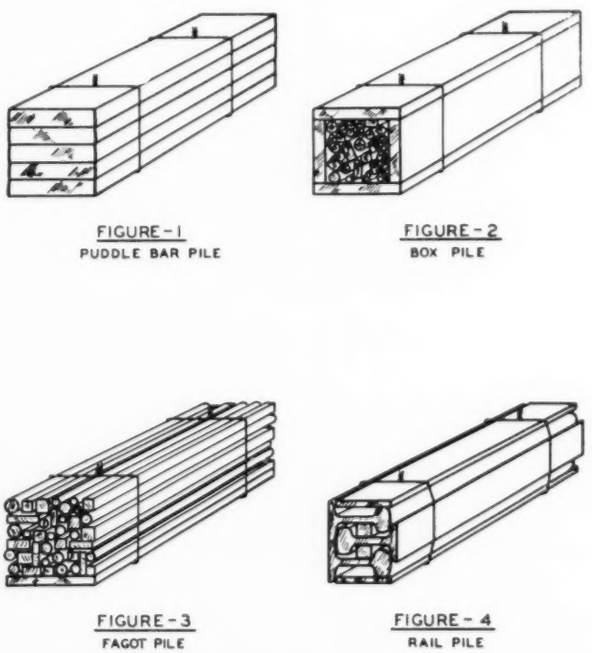
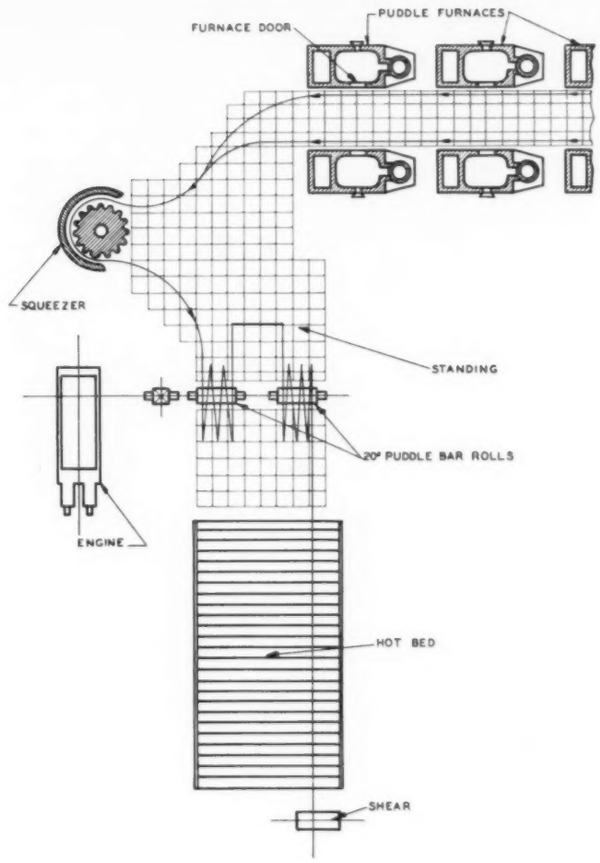


FIGURE-1
PUDDLE BAR PILE

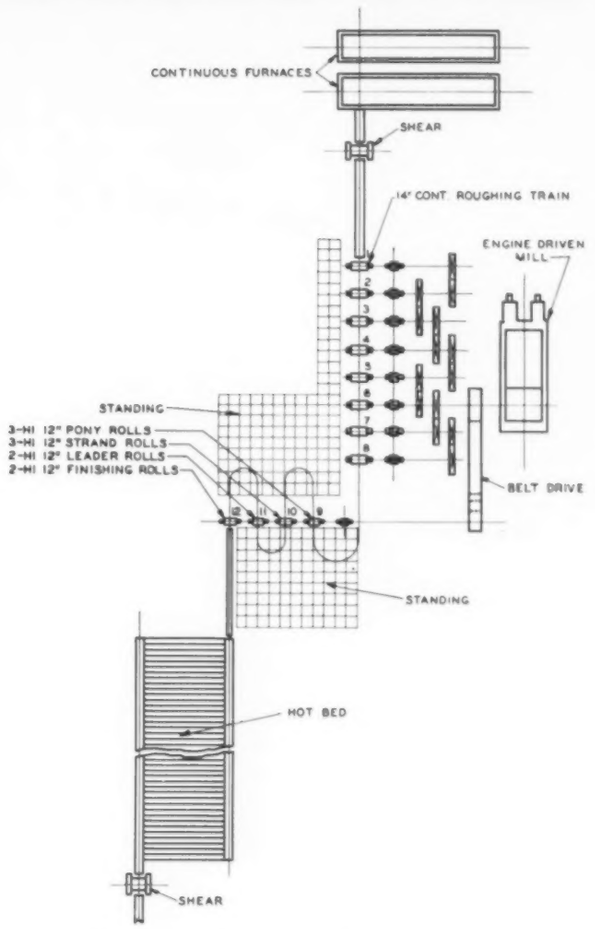
FIGURE-2
BOX PILE

FIGURE-3
FAGOT PILE

FIGURE-4
RAIL PILE



Drawing 5 — Puddle bar mill.



Drawing 6 — Bar mill with continuous rougher.

As steel billets became available, a third mill design appeared. This type of mill, shown in Drawing 6, was featured by a continuous roughing train having from four to eight roll stands in line, one pass to each stand. Between stands the bars were twisted before entering the next stand. This type of mill represented a big improvement in design and tonnage production was substantially increased. Billets from four to ten feet long were used.

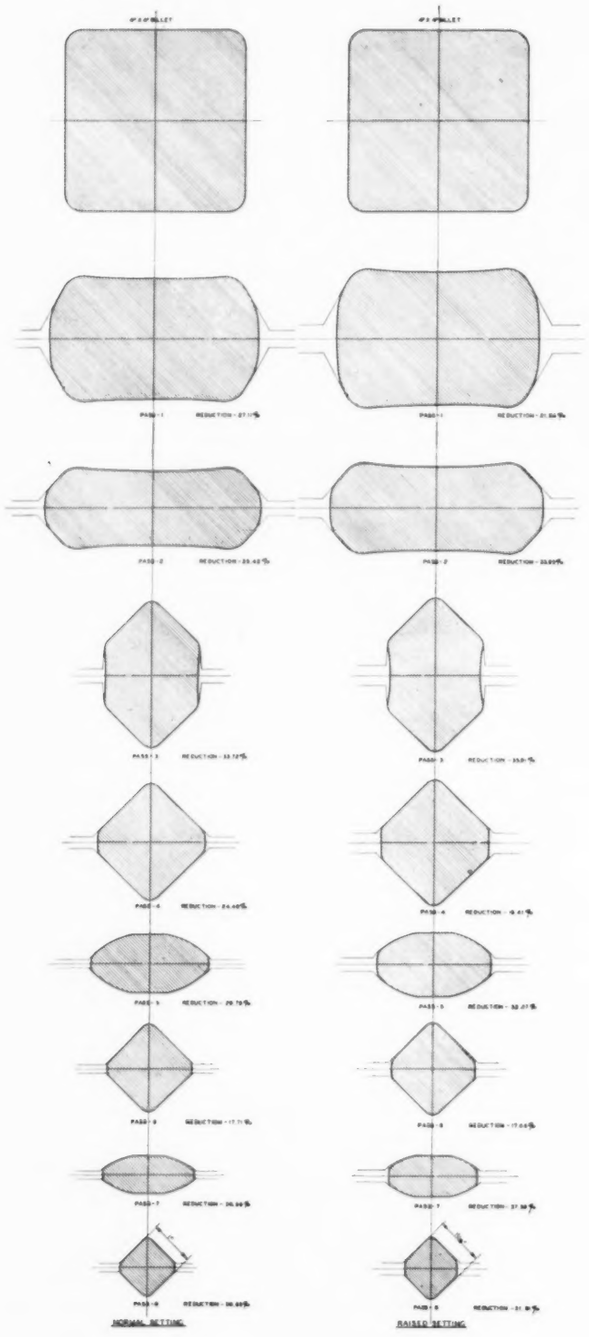
As might be expected, this new design had certain disadvantages or handicaps. The most serious trouble experienced was that heavy ragging was required on some of the passes because of the heavy draft involved. Another difficulty was that the short centers between stands caused deep scratches on the bars when they were turned by the twist guides.

Although these mills could take only a 4 in. x 4 in. billet, they were expected to deliver various sizes from the last stand in the roughing train, which complicated the rolling problem under certain conditions. Mill drives were geared so that each stand was driven at a fixed ratio with respect to the other stands and drafts were likewise established in a fixed ratio. Any change in the size of the bar delivered from the last continuous stand necessitated proportionate changes in all of the preceding roughing stands.

Thus, for example, if an increase of $\frac{1}{16}$ in. was made in the delivered size, a proportionate increase was necessary at each preceding stand, the billet size, however, remaining unchanged. This resulted in underfilling of all the earlier passes and created a bad surface condition on the bars because of the heavy scale break on the sides. Bars also had a tendency to turn over in the oval passes and in general the condition resulted in uneven cross-section in the finished bar. Both the amount of reduction (per cent) and the elongation from pass to pass were altered in making such a change in bar size and, unfortunately, the changes were incorrect for the roll speed ratios. Drawing 7 shows maximum and minimum settings for one of the pass formations used in this type mill.

Drawing 8 illustrates a later design of this type mill with eight continuous roughing stands and four finishing stands in line, but with the addition of two sets of smaller diameter rolls driven at a higher speed. These two extra finishing stands were used only for rolling the smaller sizes of bars.

The mill designs shown in Drawings 6 and 8 had rack bar type hot beds, which represented a great advance over the previous designs. The hot bed was inclined and the bars straightened themselves as they slid down the bed from rack to rack, the racks being staggered.



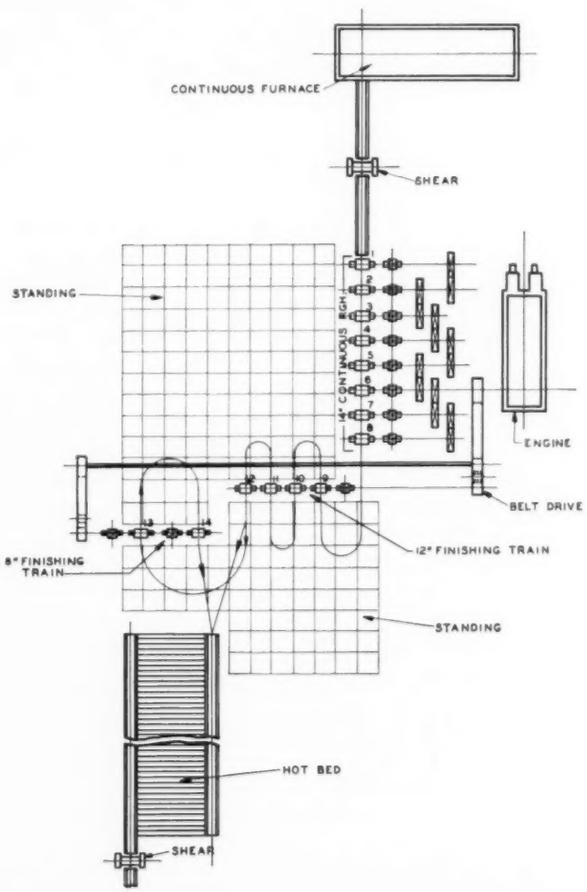
Drawing 7 — (above) Effect of raising rolls in 14 in. continuous roughing passes.

Drawing 8 — (right) Bar mill with continuous rougher.

SEMI-CONTINUOUS ROUGHING MILL

To avoid some of the difficulties encountered where all the stands in the roughing mill were coupled together with a fixed drive, a mill was devised where only part of the roughing train was continuous. This is illustrated in Drawing 9. In this mill the first two stands are independent, although driven by the same engine, the bar being in only one stand at a time. The third, fourth, fifth and sixth stands are continuous and the looping finishing mills have an extra pinion stand between the ninth and tenth stands. This permits the last three looping stands to be run at a slightly higher peripheral speed than the first three.

A still later type of semi-continuous roughing mill had the continuous stands in groups of two as shown by Drawing 10. The leader and finishing stands are independent from the rest of the finishing train. This type of mill was successful in eliminating some of the inherent faults of the continuous roughing mills, as the bars were never in more than two stands at a time. Much better control was possible in this mill when changing pass sizes. For example, if the bars delivered from the roughing train were required to be $\frac{1}{16}$ in. larger than standard, it was not necessary to increase each preceding pass proportionately throughout the entire train, as changes in the last few passes would achieve the desired result. Fewer twist guides in mills



of this type also reduced the danger of scratching the bars.

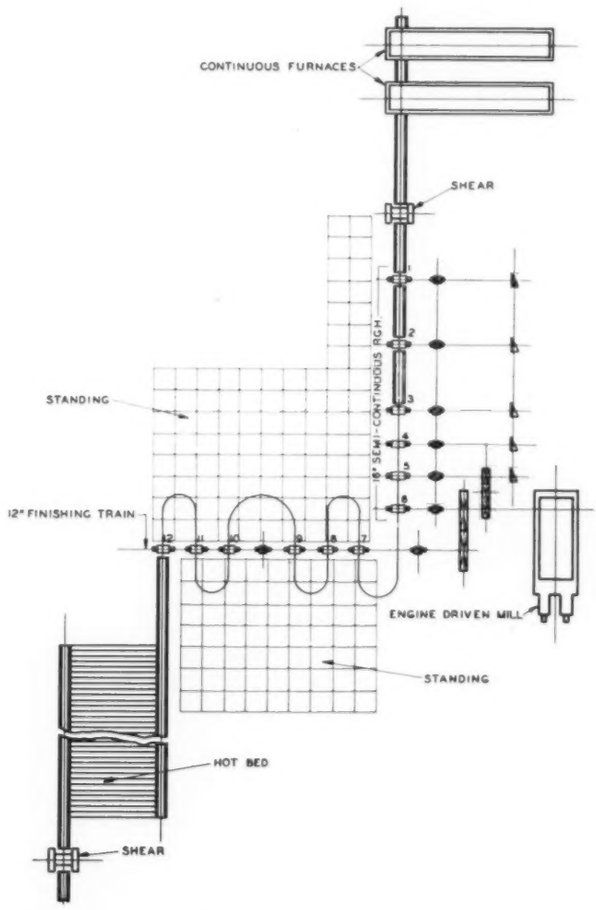
Mills of this type cannot satisfactorily roll 30 ft billets in one piece as the distance required between stand groups would be too great and also because of the temperature variation in such long billets. Ordinarily lengths not exceeding 15 ft are rolled in mills of this type.

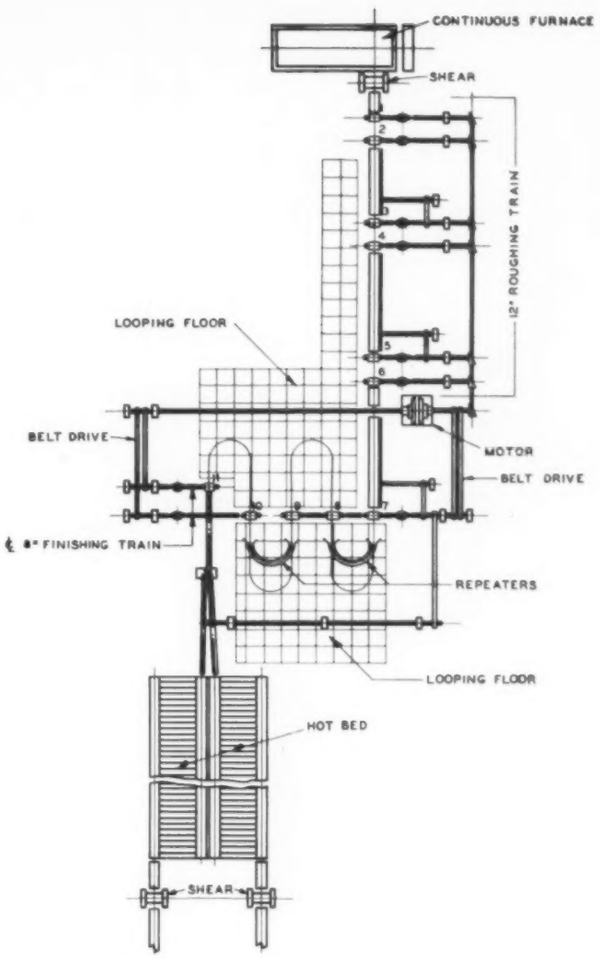
A comparatively old type of mill with a continuous roughing and a looping finishing train, designed to roll medium bar mill sizes, is illustrated in Drawing 11. This mill was most efficient with long billets and operated at a speed slow enough to allow the mill men to turn the bars between stands and passes with wrenches and tongs. The finishing train has floor loopers and the bars are in several stands at once, making possible large tonnage production. Flats, rounds and squares were the usual product rolled by mills of this type.

DRIVES

The fact that a single engine or motor was used to drive the finishing trains of the earlier bar mills, which were in line, gave rise to a number of problems. As all the rolls were practically the same diameter, the elonga-

Drawing 9 — Bar mill with semi-continuous rougher.





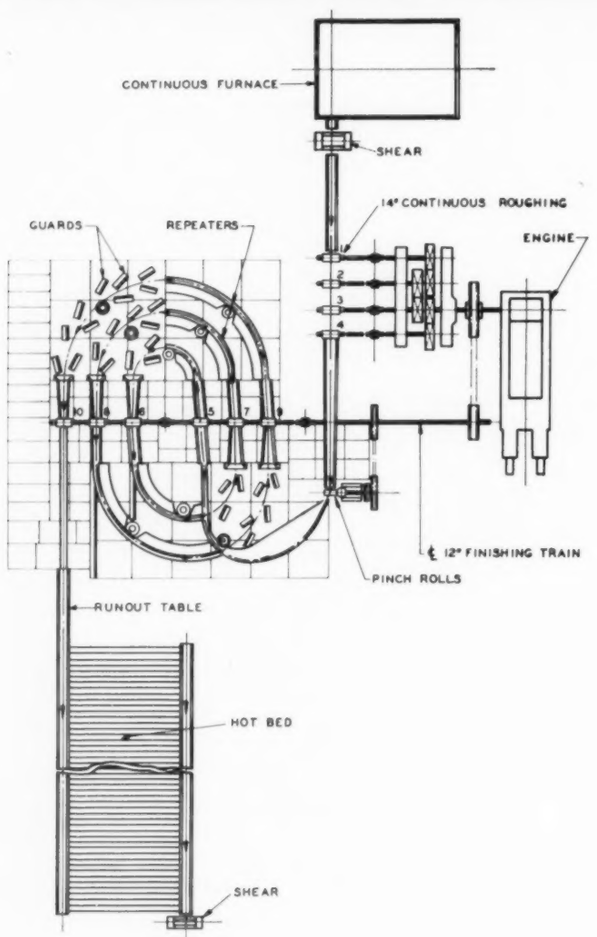
Drawing 10 — Bar mill with semi-continuous rougher.

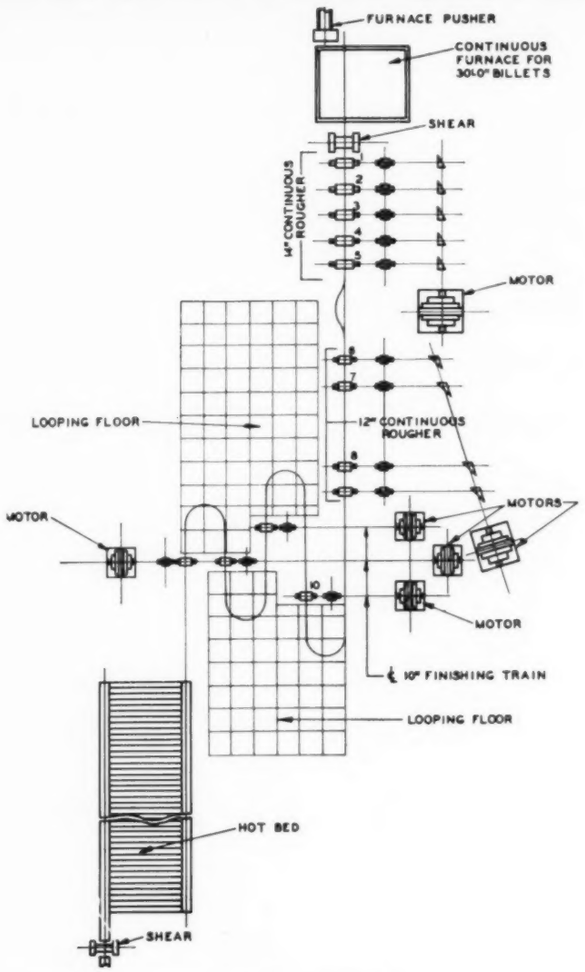
tion caused by the reduction in size of the bar from stand to stand caused increasingly long loops to form between the passes. This condition increased the time required for the bars to go through the finishing train and at the same time resulted in a considerable variation in temperature from the front to the back end of the bar.

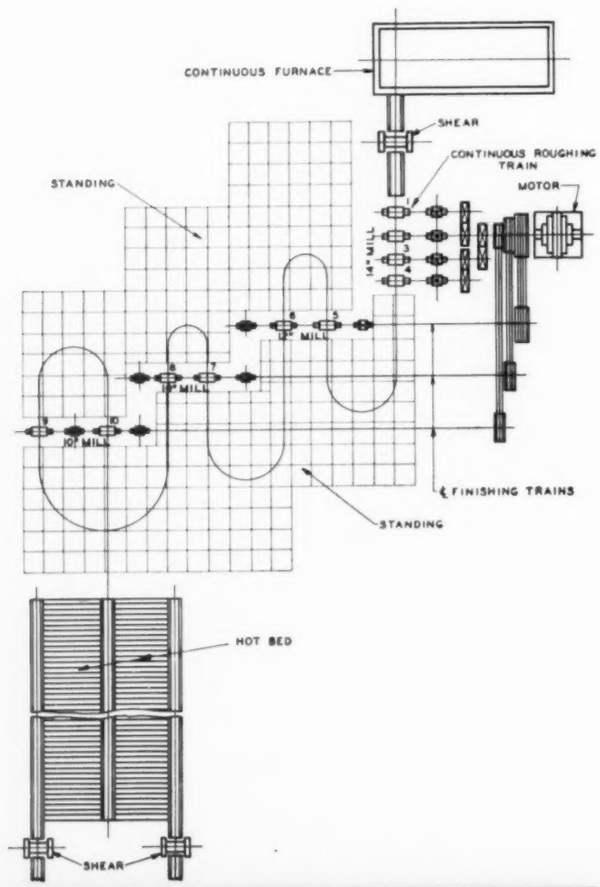
An attempt to solve this difficulty was made by breaking up the finishing train into groups of two stands, each group being driven independently as shown in Drawing 12. This was a distinct improvement, as the lengths of the loops were cut down between groups, although the loops were still present in each group.

Drawing 13 shows a still better type of mill, in which each stand of the finishing train is independently driven by a variable speed motor. This gave perfect control of the loops. In this mill design the roughing train was broken into two parts, each being driven by a separate motor.

Mills using 30 ft billets still had trouble in the continuous roughing trains because of stands being coupled together. To overcome this condition, improved designs were developed in which groups of various sizes were independently driven by a separate motor. One of the







Drawing 11 — (top left) 12 in. looping bar mill.

Drawing 12 — (bottom left) Bar mill with three finishing trains.

Drawing 13 — (top right) Continuous rougher with two drives; independent finishing train drive.

best solutions was accomplished by driving each stand, except the first two, by a variable speed motor. Such a mill layout is illustrated in Drawing 14.

TWIN BAR MILL

Progress in bar mill design did not stop after the successful development of continuous roughing trains and looping finishing trains. The next problem attacked was that caused by the fact that, due to the longer loops in the finishing train, it took longer to finish a bar than it did to pass it through the roughing train. A mill was therefore designed with two finishing trains fed from one roughing train. The same double hot bed was used by both finishing trains. This is shown in Drawing 15.

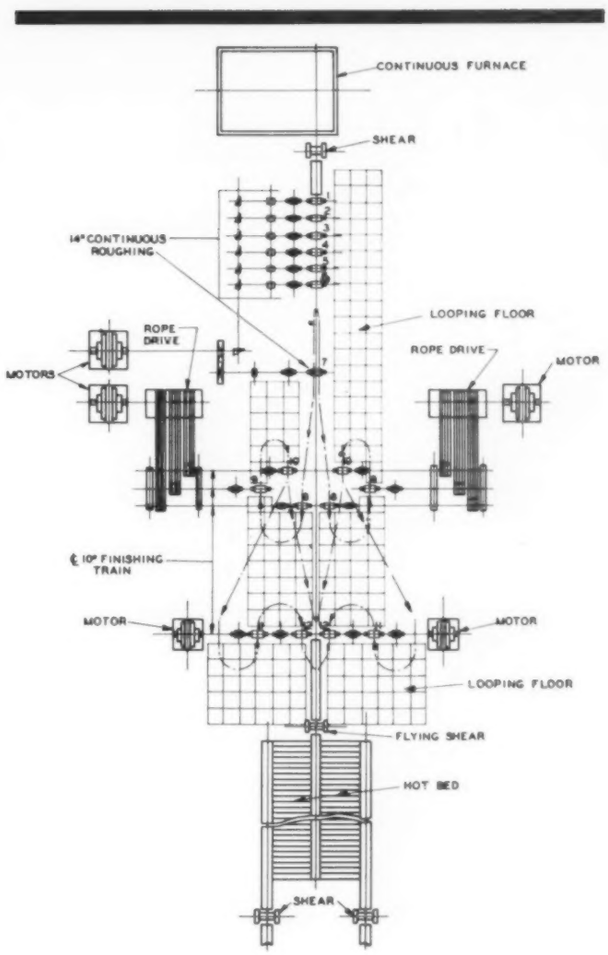
This scheme possessed the additional advantage that either finishing train could be shut down for roll changes while the other was in full operation. Such a mill could roll substantially more tonnage than the older mills, the

only additional expense involved being the cost of the extra finishing train and a few more men to operate it.

Drawing 16 illustrates one of the attempts to solve the problem of time loss caused by roll and section changes. This mill had three outlets to the hot bed, discharging from stands eight, ten, and twelve. The principal advantage of this design was that, although the same sized billet was always delivered from the roughing train, a variety of round bar sizes could be rolled in the finishing stands. In the majority of these sizes it was unnecessary to change passes and sizes in the roughing mills, with the result that the down time of the mill was reduced considerably.

CROSS COUNTRY BAR MILL

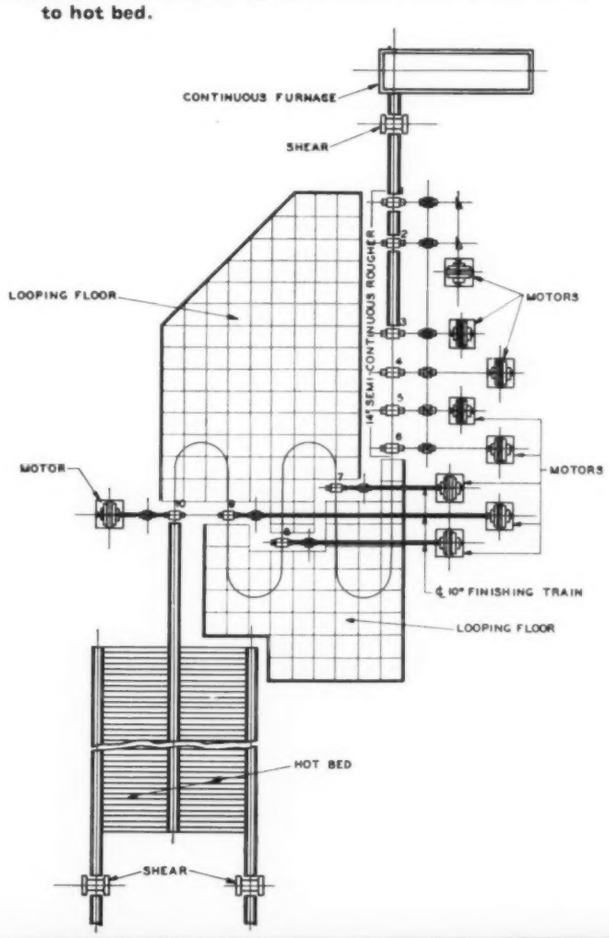
A mill of this type can be designed to roll a wide range of sizes, the mill illustrated in Drawing 17 being capable of rolling rounds and squares from ½ in. to 5 in., flats from ¼ in. x 1 in. to 10 in. x 2½ in. and other sizes in proportion. The advantage of such a mill to a producer who does not care to invest in a number of mills to roll this range of sizes is obvious. Ordinarily such a range would require at least three bar mills of different sizes and if the potential tonnage warranted the investment the three mills would be preferable since rolling costs per ton would be lower.

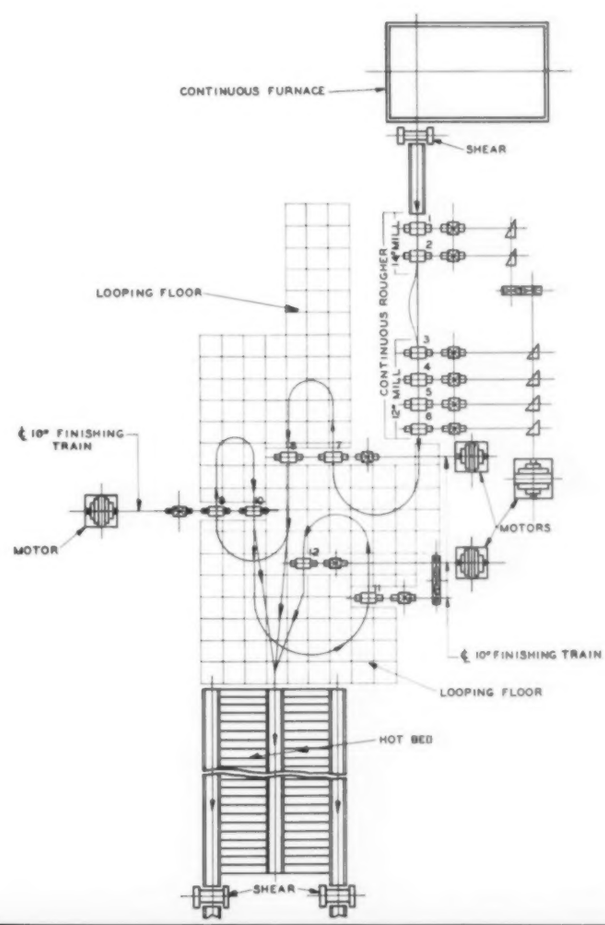


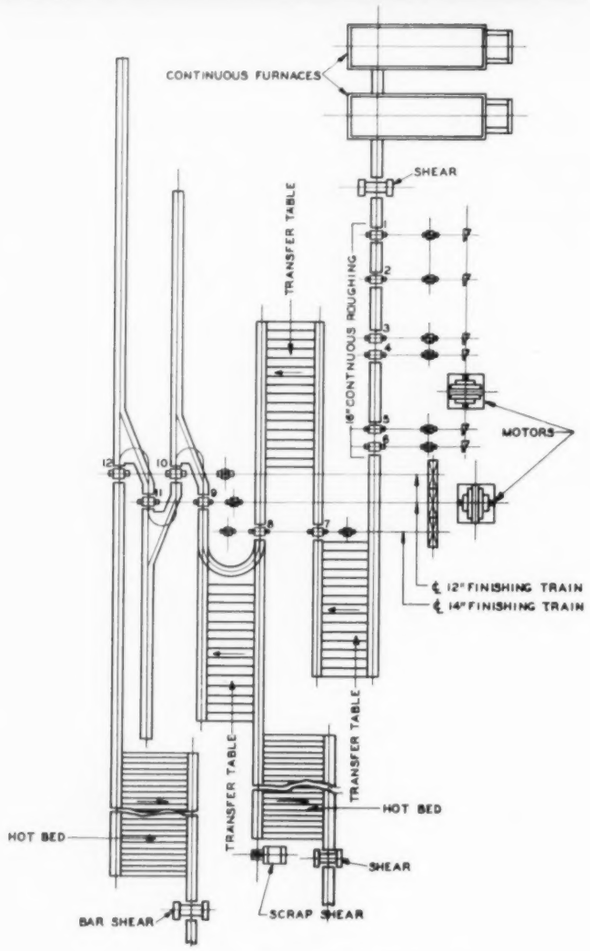
Drawing 14 — (bottom left) Bar mill with roughers and finishers independently driven.

Drawing 15 — (top right) Twin bar mill.

Drawing 16 — (bottom right) Bar mill with three outlets to hot bed.







Drawing 17 — Cross country bar mill.

Where tonnage, however, does not justify the expense of installing three mills, a flexible installation of the cross country type is desirable. One disadvantage of these mills is that they require a large number of billet sizes and considerable time is required for roll changes. Advantageous, however, is the fact that bars can easily be looped or run out on tables in the last finishing stands. The two hot beds are also desirable, since when the first hot bed is in use for larger sizes, the roll stands preceding the other hot bed can be changed to handle the next section scheduled for rolling.

Drawing 18 illustrates the layout of another type of bar mill designed to handle medium sizes. This mill is of the cross country type, but contains a number of modifications. The roughing train is semi-continuous, for example, and there are some cross country stands with runout tables, followed by three continuous finishing passes. The chief advantage of this design is in the continuous finishing. Properly designed and operated, such a mill can finish longer length bars at a relatively high speed, which results in greater tonnage and at the same time makes it possible to maintain considerable accuracy of section. These advantages can be attained with a smaller operating crew than would be necessary on comparable mills having independent finishing stands.

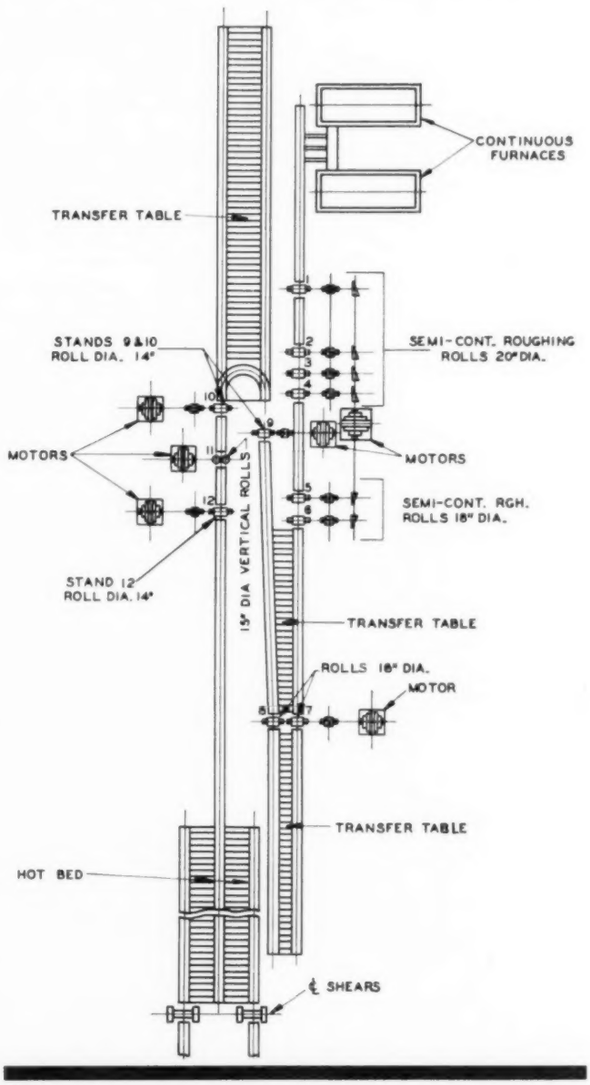
CONTINUOUS BAR MILL

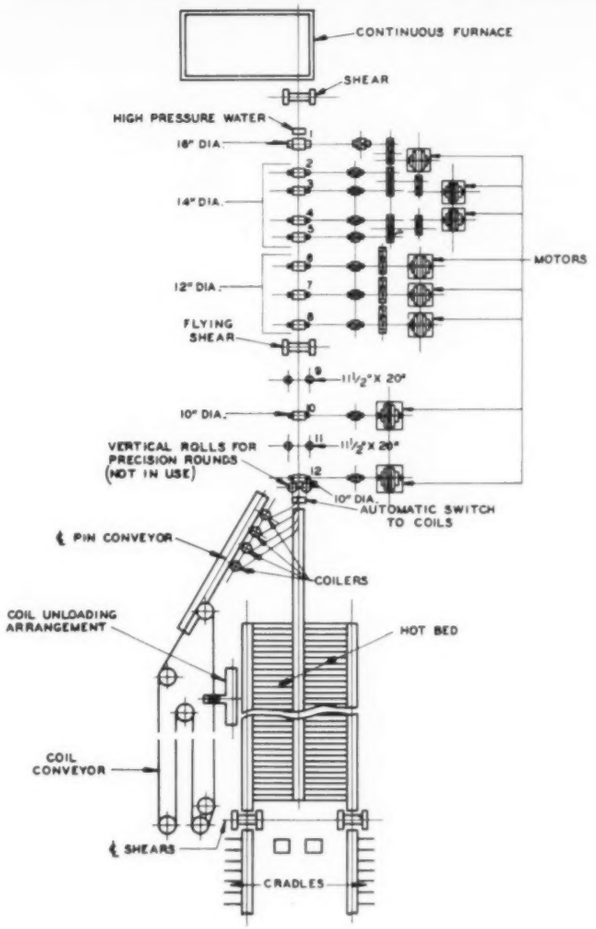
The previously mentioned smaller bar mills with looping finishing stands of the most improved type were limited by the speed of the finishing stand, for a roll and bar speed of 1400 to 1600 feet per minute is about as fast as any catcher can work satisfactorily. As the speed of the bar through the finishing pass governs the tonnage produced by the mill, means were sought to increase this speed.

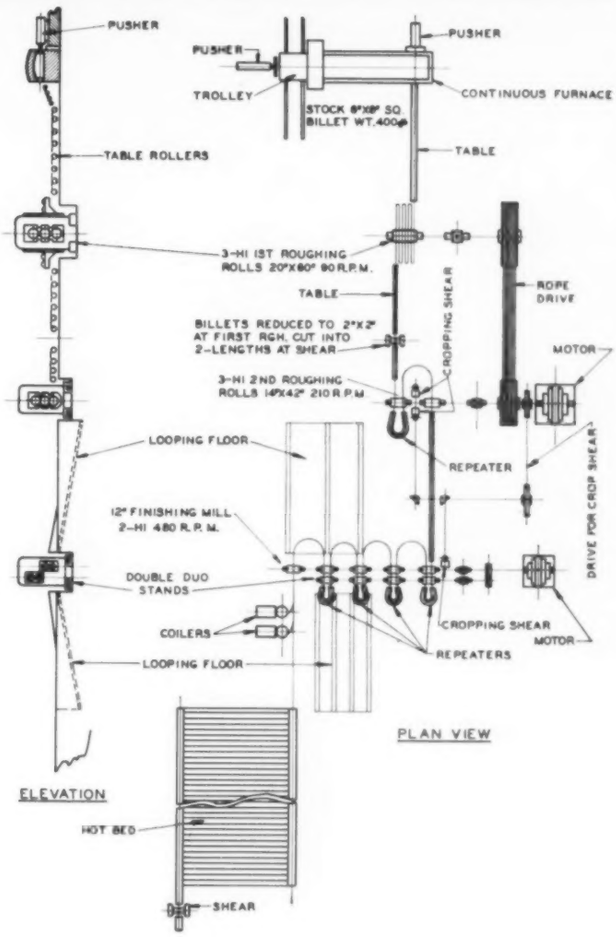
Using repeaters instead of catchers solved one phase of the problem, but twisters still gave trouble. These units caused scratches on the bar and it was also found that bars twisted into the finishing pass were not as accurate in section as were those entered without twisting.

These problems, however, were solved by a straight continuous bar mill having the last few stands alternately horizontal and vertical so as to eliminate the necessity for twisting between these finishing stands. Such a layout is shown in Drawing 19. With such a design, catchers were no longer necessary and conse-

Drawing 18 — Cross country mill with continuous finisher.







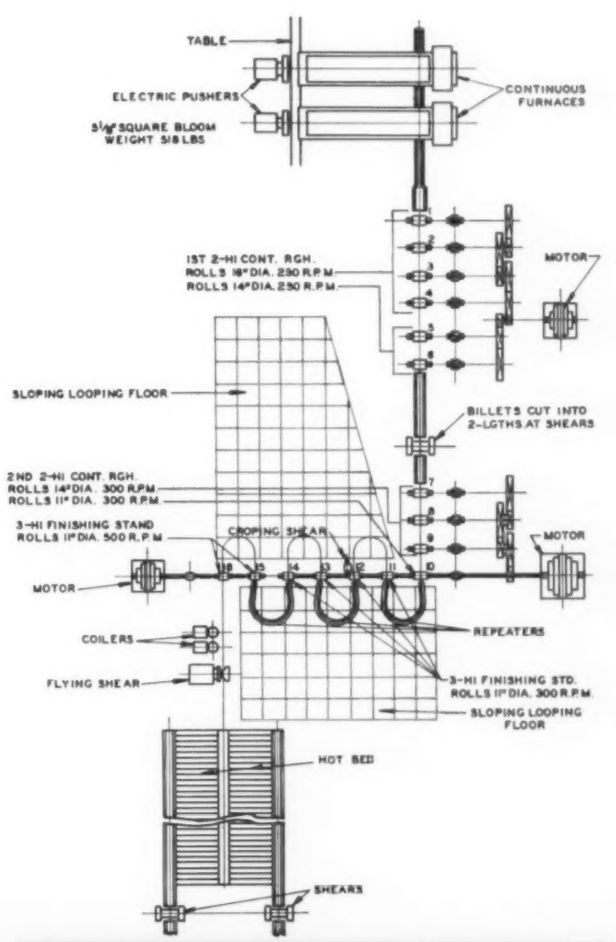


TABLE
ELECTRIC PUSHERS
CONTINUOUS FURNACES
5¼" SQUARE BLOOM WEIGHT 518 LBS
1ST 2-HI CONT. RGH. ROLLS 16" DIA. 250 R.P.M. ROLLS 14" DIA. 250 R.P.M.
MOTOR
SLOPING LOOPING FLOOR
BILLETS CUT INTO 2-LGTHS. AT SHEARS
2ND 2-HI CONT. RGH. ROLLS 14" DIA. 300 R.P.M. ROLLS 11" DIA. 300 R.P.M.
3-HI FINISHING STAND ROLLS 11" DIA. 500 R.P.M.
CROPING SHEAR
MOTOR
MOTOR
COILERS
REPEATERS
FLYING SHEAR
3-HI FINISHING STD. ROLLS 11" DIA. 300 R.P.M.
SLOPING LOOPING FLOOR
HOT BED
SHEARS

Drawing 19 — (top left) Continuous bar mill.

Drawing 20 — (top right) Continental double-duo bar mill.

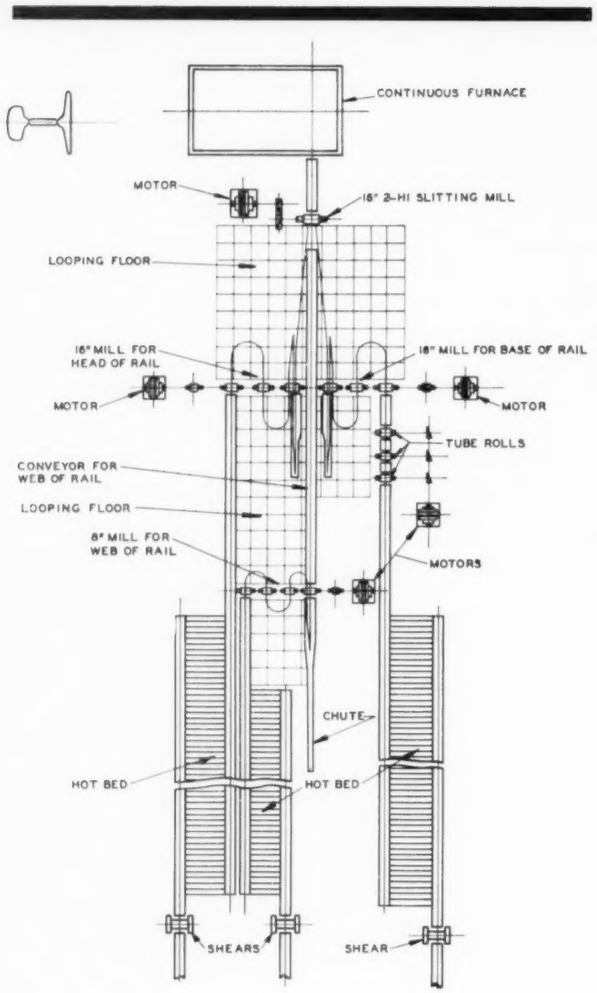
Drawing 21 — (bottom right) European bar mill with semi-continuous rougher.

quently the finishing speed could be raised to nearly twice that formerly possible. At the same time, the problem of loops between stands was easily controlled by driving each stand with an individual motor.

This type of bar mill represents the latest advance in this country for small and medium size products and is one of the most successful. Its labor cost is low, but it is not suited for job work, being most suitable for rolling large tonnage schedules of the same section.

FOREIGN MILLS

Progress in bar mill design went forward in Europe as well as in the United States. Among other improvements, the double-duo roll stand illustrated in Drawing 20 was invented. In this stand, two pairs of rolls were mounted over, but slightly to one side of each other in the same housing, turning in opposite directions. The mill used a 6 in. x 6 in. ingot weighing 400 pounds. The first roughing stand was a three-high unit, with rolls 20 in. x 60 in., and broke down the 6 in. x 6 in. ingot to a 2 in. x 2 in. square. On its way to the second



roughing operation, which was accomplished by two three-high stands of 14 in. x 42 in. rolls, the billet was but in half by a shear.

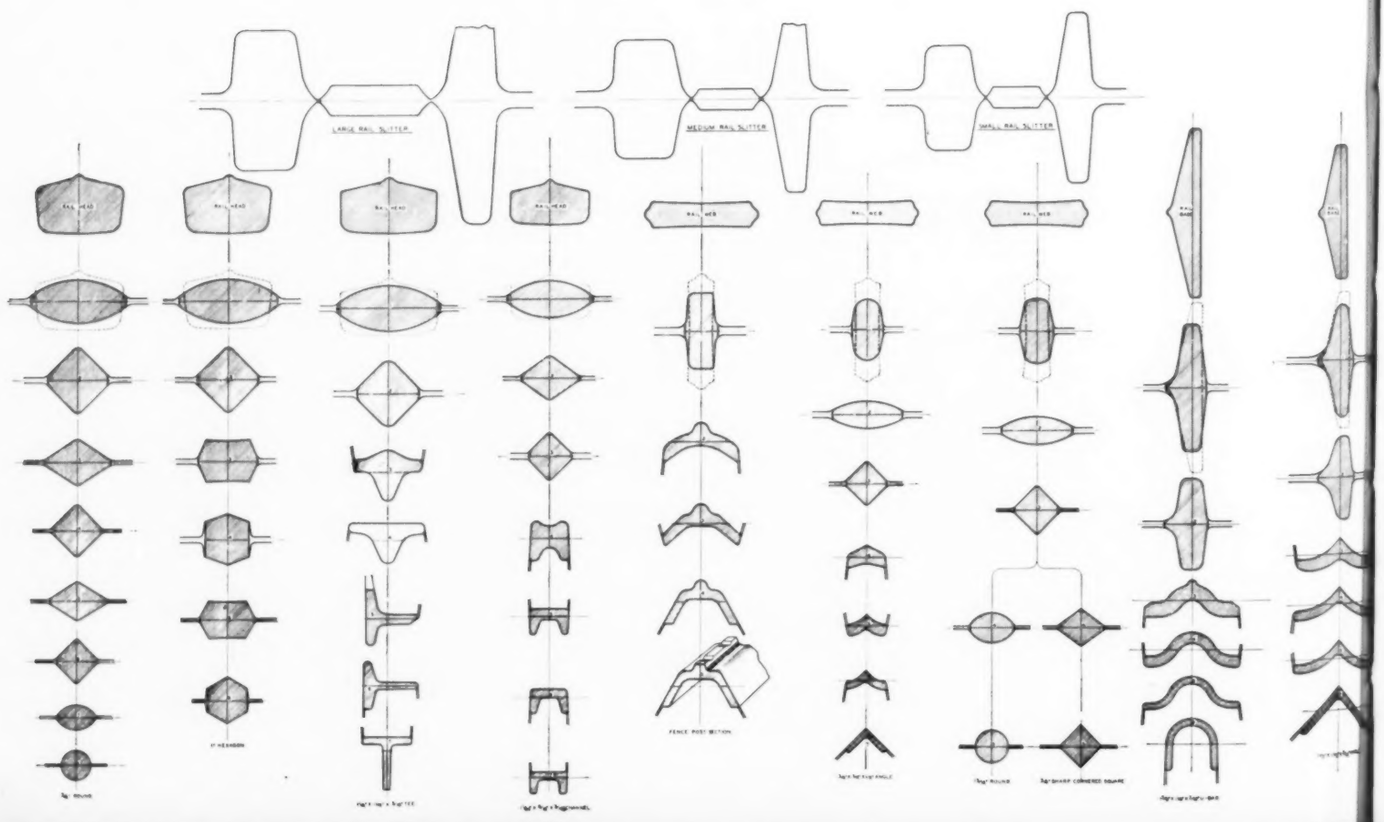
After leaving the 14 in. mill the bars were looped through four double-duo stands and one two-high finishing stand, the bars being either coiled or run out on the hot bed. This mill finished the bars at 480 rpm or approximately 1500 feet per minute and had a small bar production of about 6 tons per hour.

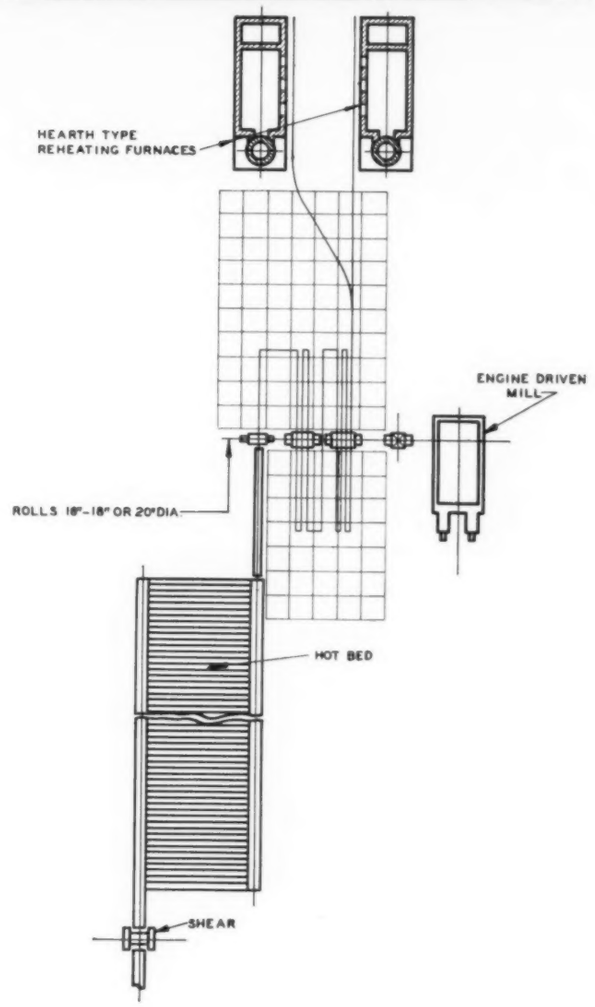
One of the features of this mill was the use of repeaters on one side of the mill. These repeaters took the bar from the bottom pair of rolls in the duo stand and looped them into the top pair of rolls. Another point of interest is the fact that 6 in. square stock is used, a size considerably larger than that commonly used for rolling small bars.

Another French mill had a semi-continuous roughing train and a looping finishing train as shown in Drawing 21. The mill was served by two continuous furnaces and used 5⅛ in. square billets weighing 518 pounds. After leaving the furnace the billets passed through a six-stand, two-high continuous roughing train. The first four stands were equipped with 16 in. diameter rolls and the last two with 14 in. rolls. Following this mill is a shear for cutting billets in half, after which they run out on a table, and then enter the second continuous two-high roughing train. This consists of three stands of 14 in. rolls and one stand of 11 in. rolls. On leaving this roughing train, the billet is looped into four stands of 11 in. rolls set in line and driven by the same motor. Next come two more final finishing stands of 11 in. rolls, driven by another motor. The oval to square loops are handled by hand, but the square to

Drawing 22 — (left) Rail slitting bar mill.

Drawing 23 — (bottom) Sections rolled from slit rails.





Drawing 24 — Simple three stand bar mill for large sections.

oval loops are run around repeaters. Oval to round is handled by hand. The speed of the finishing train is 500 rpm, or 1440 feet per minute.

This mill rolls rounds and squares to a minimum size of $\frac{15}{64}$ in., flats down to $\frac{7}{16}$ in. wide, angles $\frac{5}{8}$ in. x $\frac{5}{8}$ in. minimum, small channels and tees $\frac{45}{64}$ in. x $\frac{45}{64}$ in. A rotary flying shear is available to cut the mill product to hot bed lengths. Production from this mill is from 5 to 10 tons per hour, depending upon the sections being rolled.

RAIL SLITTING MILL

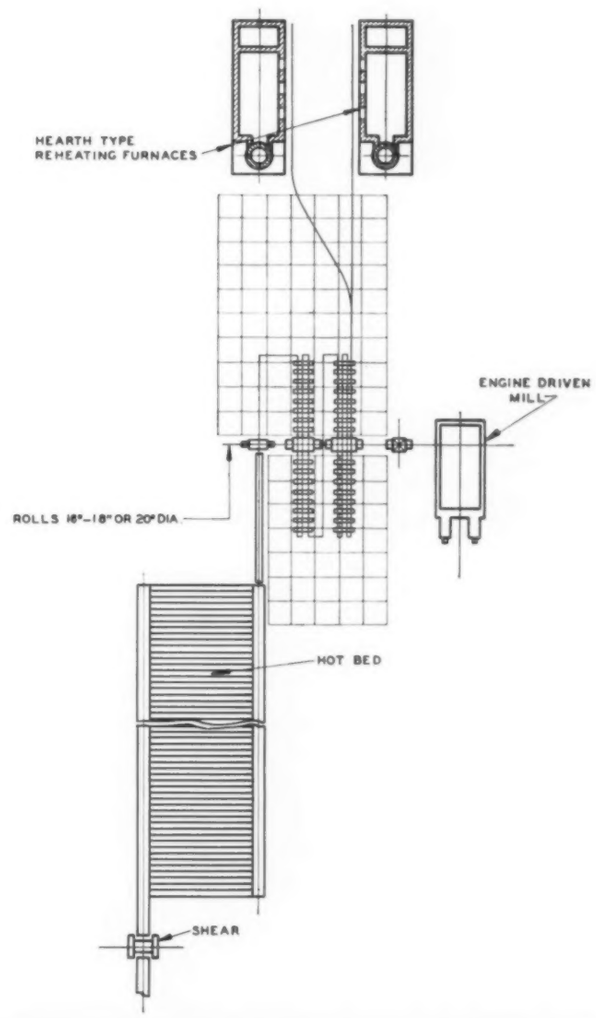
Scrap rails are converted into a variety of other useful products in rail slitting mills such as are illustrated in Drawing 22. After being raised to rolling temperature in a continuous furnace, the rail is slit in the first pass into three parts, head, web, and base. Each of these sections moves forward to a separate roll train, without reheating. This type of mill is very successful in rolling concrete reinforcing bars, fence post sections and a considerable variety of other small shapes and sections. Another commodity rolled is pipe, which is rolled from the base of the rail into a flat and then formed into a tube in three continuous stands, after which it is welded.

The products rolled from old rails are not of the best quality. Too often the bars have laps and seams rolled in from the sharp slit edges. This, however, is not too serious a factor since the product is never applied to exacting use in the field. Drawing 23 shows a variety of products commonly rolled from old rails.

LARGE BAR MILLS

Most of the mills described so far have been designed to roll small and medium bar mill sizes. The larger bar mills, usually 18 in. and 20 in., in their earlier forms were much the same as the smaller ones. They used heavier stock piles, and when steel billets came into use, heavier billets than the smaller mills. Some of the larger mills used cast ingots directly where blooming mills were not available. These ingots ranged in size from about 5 in. x 5 in. to 12 in. x 12 in. in cross section. The first mills were hand operated, using hooks and tongs to handle

Drawing 25 — Three-stand bar mill with table rolls in floor.



the stock. Later, table rolls were installed in the floor to ease the tongmen's work. Still later, tables were adopted, eliminating most of the hand work.

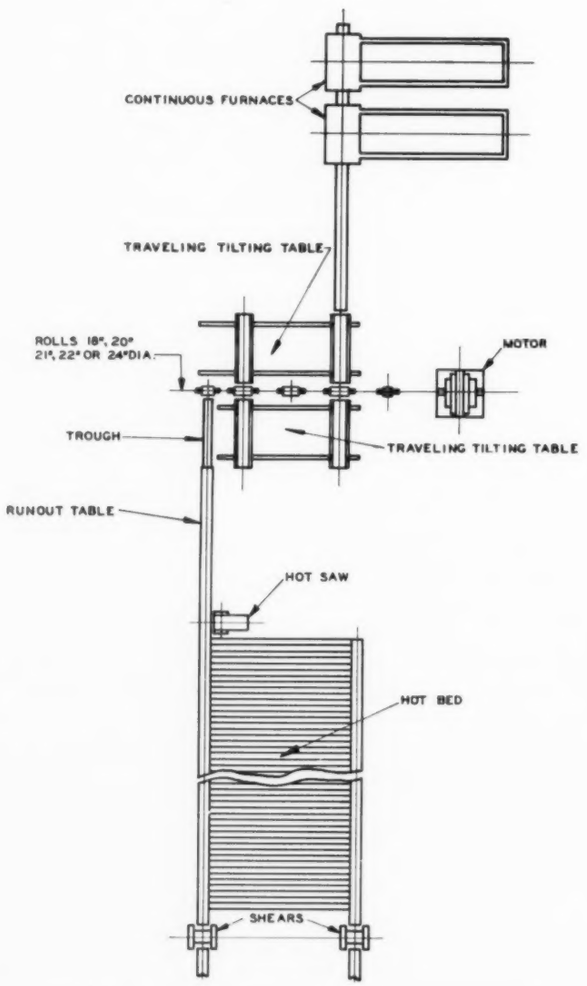
Rounds and squares up to 8 in. in diameter were rolled by these mills and in some cases, large flats and even rails and certain other sections. Drawing 24 illustrates an early type hand-operated, large bar mill.

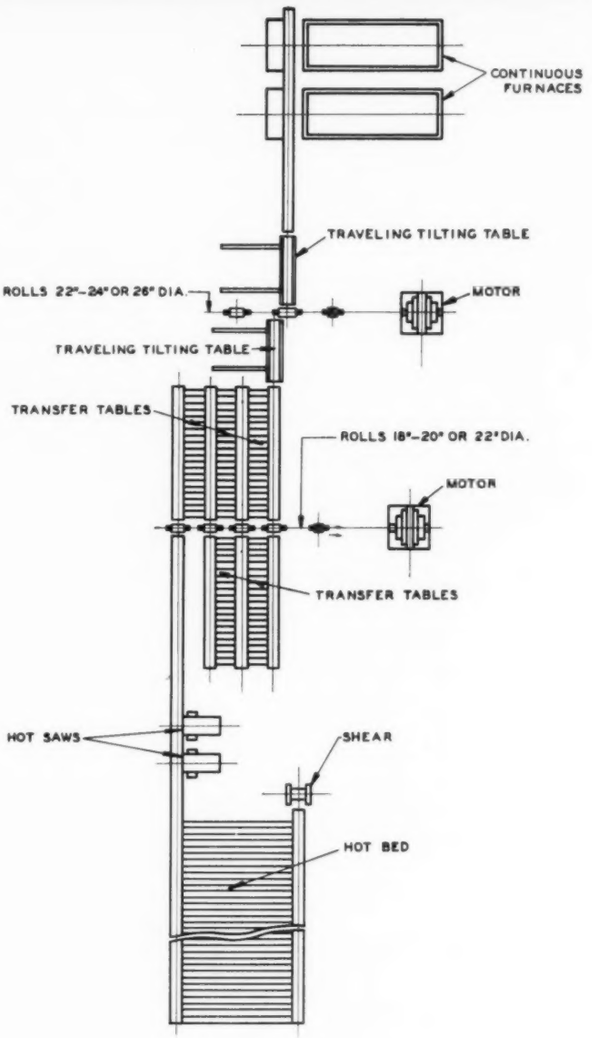
A slightly more modern design is shown in Drawing 25. This mill has tables recessed in the floor to facilitate the movement of heavy bars and lighten the work of the tongmen.

Drawing 26 illustrates a more up-to-date installation with tilting tables. This mill is designed to roll small structural shapes as well as heavy bars.

A more elaborate design is shown in Drawing 27. Here an attempt has been made to provide a roll and pass design which will minimize roll and pass changes. The second train of rolls is set up with a number of sizes and any one or two of the sets may be used for rolling a certain size product while the other stands remain idle.

Drawing 26 — Bar mill with traveling tables.





Drawing 27 — Large bar mill with separate rougher.

FURNACES

Stock for the early bar mills was usually heated in a coal fired furnace, an early type furnace being shown in Drawing 28. This type of furnace did not burn the coal efficiently and designers soon added upright steam boilers to the unit so as to utilize the waste heat from the furnace. Steam from these boilers was used to drive the steam engines which powered the mills as well as for various other purposes around the plant. When these boilers were added, the stack was moved back of the furnace.

Producer gas later replaced direct coal firing at the furnaces, giving greater fuel economy, but waste heat boilers were still used to conserve fuel.

As the steel billet came into use, continuous furnaces were developed and these were so economical that boilers were seldom used in connection with the furnaces. Drawing 29 illustrates an early type continuous furnace for use with short billets.

BAR MILL HOUSINGS

The earliest bar mill housings were of very simple construction. Roll setting was accomplished by means of liners between the housing carriages. In many cases the three-high housings were designed with closed tops, the rolls being removed through the housing windows. Two-high sets, however, usually were of open top design, the caps being removed for roll changes. Figures 1 and 2 in Drawing 30 illustrate these early types. Wooden bearings were installed between the top and bottom rail necks in the two-high housings, wedges being used to force the rolls against the top and bottom bearings. Two more modern and more efficient housing designs are illustrated by Figures 3 and 4, Drawing 30.

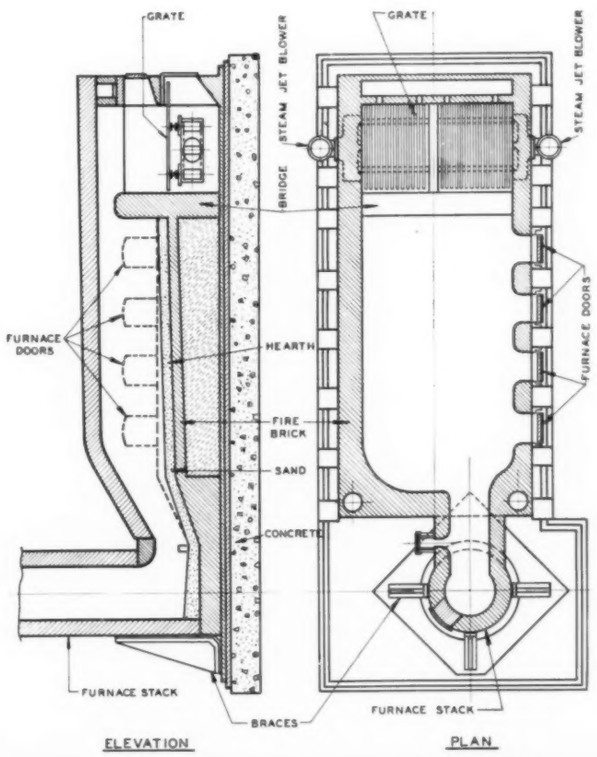
The old two-high housing had certain advantages, however, such as the absence of spring in the rolls, secured by the wedges used between the two roll necks.

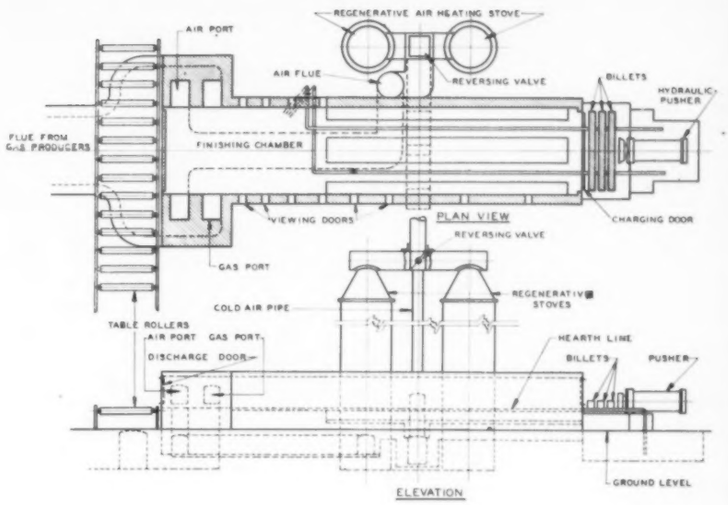
Guides were also simple in construction in the early days of bar mill design. Roughing and strand delivery guides were particularly simple. Strand delivery guides as shown upper left, Drawing 31, were merely a sheet iron plate arranged to fit over all or part of the passes, with adjustable clamps to serve as side guards and assure straight delivery from a pass. Roughing delivery

Drawing 28 — (bottom left) Coal fired reheating furnace for iron piles.

Drawing 29 — (top right) Early type continuous furnace for short billets.

Drawing 30 — (bottom right) Bar mill housings.





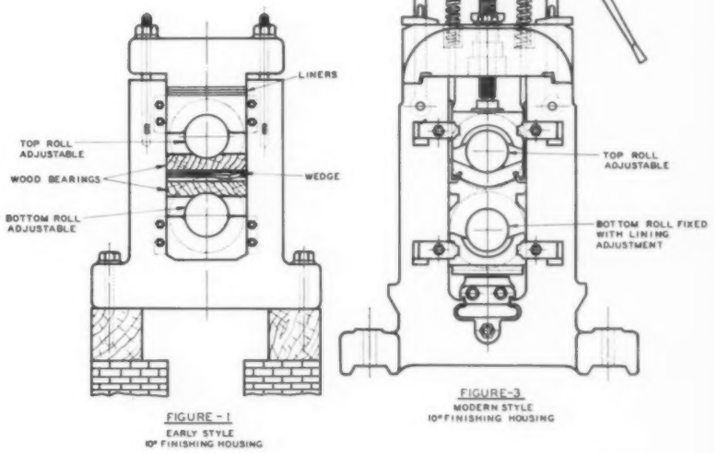


FIGURE-1
EARLY STYLE
10" FINISHING HOUSING

FIGURE-3
MODERN STYLE
10" FINISHING HOUSING

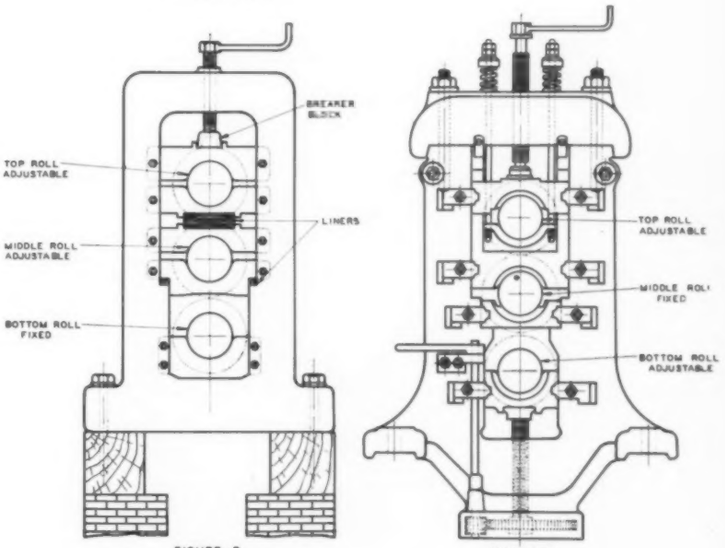
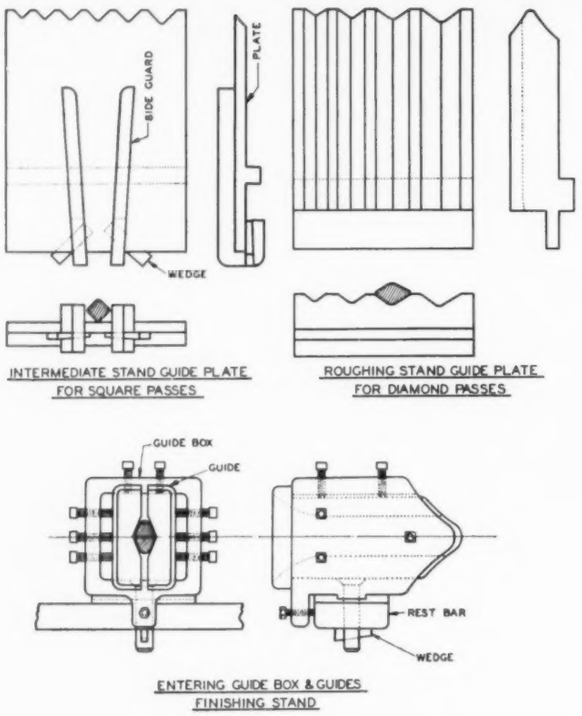


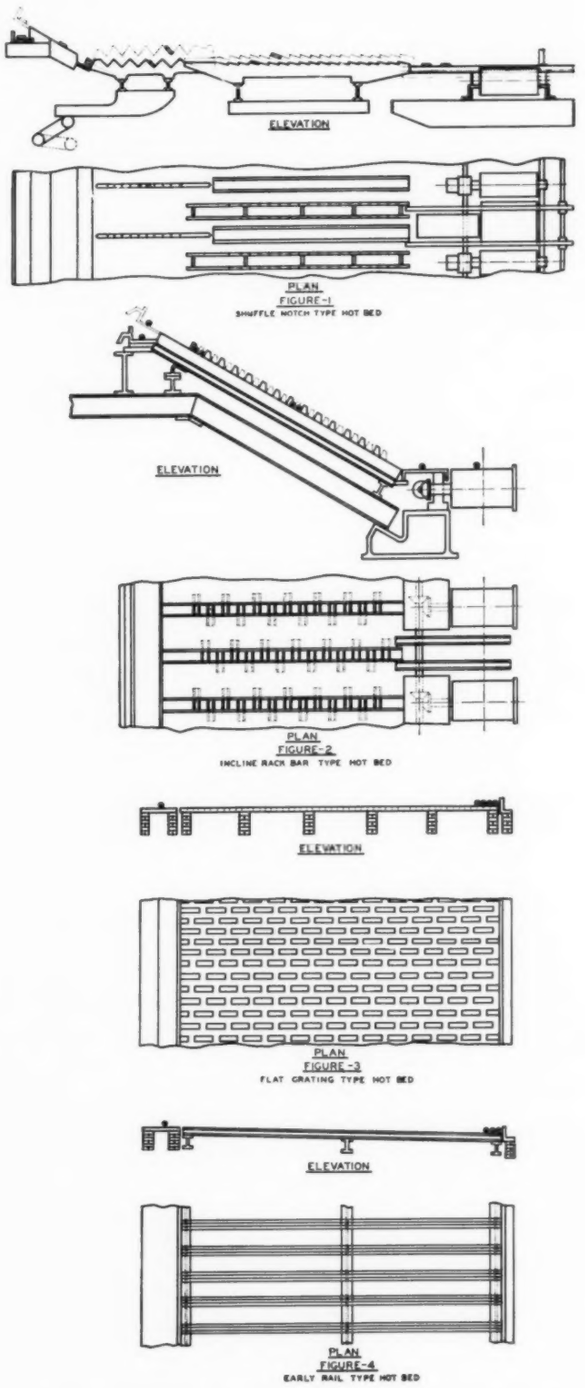
FIGURE-2
EARLY STYLE 3-HI
10" FINISHING HOUSING

FIGURE-4
MODERN STYLE
3-HI 10" FINISHING HOUSING



Drawing 31 — (left) Bar mill guides.

Drawing 32 — (below) Types of bar mill hot beds.



guides, as shown upper right, were castings, usually with about four passes per piece. They were ground in to fit the roll by using sand between the roll and the guide. The lower sketch shows an entry guide box for a finishing stand rolling a round from an oval.

HOT BEDS

The first hot beds were of rather simple construction. Some of those used on puddle mills consisted of iron gratings, level with the mill floors, the bars being pulled down from the mill directly onto the hot bed. In many plants, pieces of wood were laid on the mill floor to serve as skids, since the hot bars slid easily over the wood.

Another early type of hot bed consisted of rails, with an iron or steel plate in line with the finishing stand. From this plate the bars were pulled over the rails by boys at each end of the bar. If the bars were large and finished in the strand, the hot bed boys pulled them onto the plate, where the kinks were removed by hammering with a heavy wooden mallet. After straightening, these bars were pulled over the hot bed for shearing.

The mechanical hot bed was developed to meet the needs which arose as bars were rolled in longer lengths. One of these was the incline type. In this design the bars were run uphill on rollers and then over level rollers to an inclined set of rack bars where they were racked down to floor level for shearing. Straightening of the bars took place during the racking operation. In another more modern type of bed, the bars were mechanically racked across the bed.

Some of the more modern beds having packing devices for bars which require pack annealing on the bed, and many mills now have coilers to coil the bars direct from the finishing stand.

Drawing 32 illustrates a number of hot bed designs, Figure 1 at the top showing the shuffle notch type, Figure 2, the incline rack bar type, Figure 3, the flat grating type, and Figure 4, the early rail type.

ROLLS

The earliest types of rolls for bar mills were made of sand iron or plain steel. Chill iron rolls were introduced rather early in the development of bar mills, being first used for rolling sheets and then for leader and finishing passes rolling rounds, squares, and flats. The so-called semi-steel rolls were made from a mixture of iron and steel. Various types of alloy steels were used for roughing and strand pass rolls, followed by a variety of grain type rolls, including both the chill type and those where deep penetration of the desired close grained structure is achieved by the alloying elements added to the metal.

Continuous mill roughing stands were formerly equipped with rolls in which the passes were chilled-in close to the finished size and shape. These rolls are expensive to make and are seldom used now except for finishing rolls to handle certain shapes. This type of chilling should not, however, be confused with the regular chill rings used with alloy steel rolls. There the chilling rings have a coating of sand and are embedded in the mold closely following the contour of the passes.

Experience has demonstrated that hard rolls wear better than soft rolls. Machining and grinding difficulties, however, limit the degree of hardness that is practical. Passes harder than 75 Shore hardness cannot be turned with any of the tools now available, although plain flat rolls up to 90-100 Shore hardness may be surfaced by grinding.

Many kinds of analyses are used for roll construction, ranging from plain carbon steel up to the hardest nickel chill types of metal. Plain carbon steel, however, is not now used to any great extent.

There are many types of grain rolls. Some are for rolling small shapes, with passes cut deep into the rolls. These are alloyed with nickel to develop deep penetration of the desired close grained structure. Chromium and mixtures of chromium and nickel are also used to develop hardness and grain structure in other cases. The following specifications are typical of the chemical analyses used for preparing metal for use in bar mill rolls:

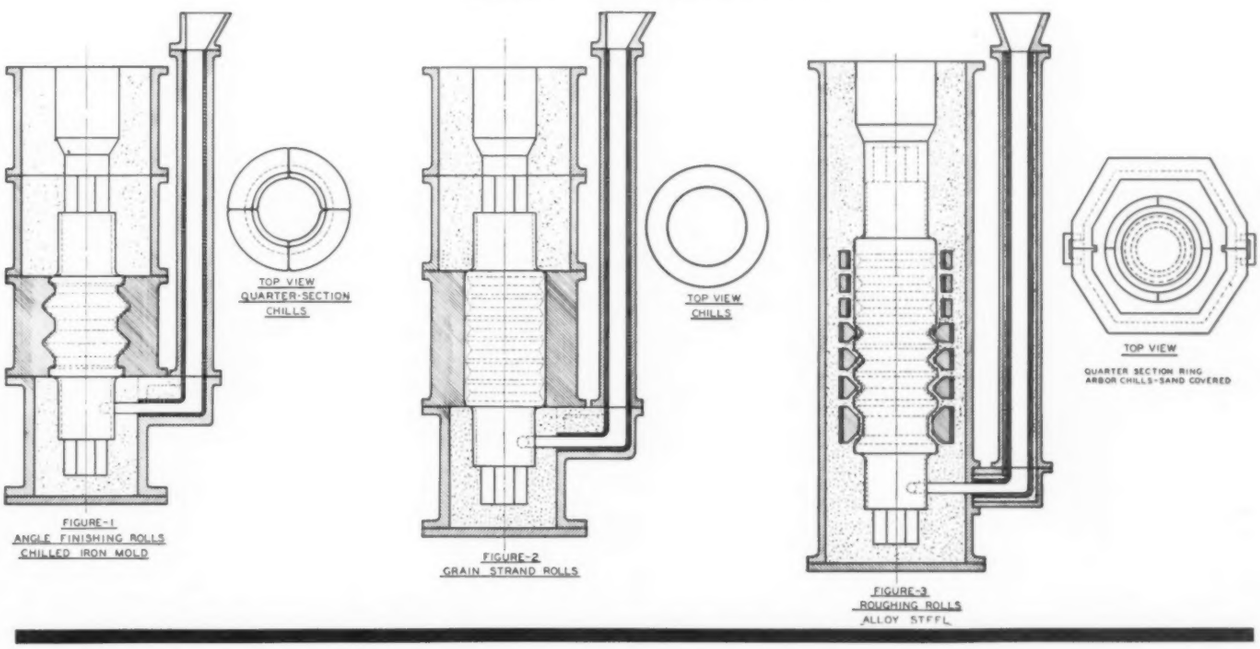
Plain chilled iron roll with 1½ in. clear chill, for 12 in. mill

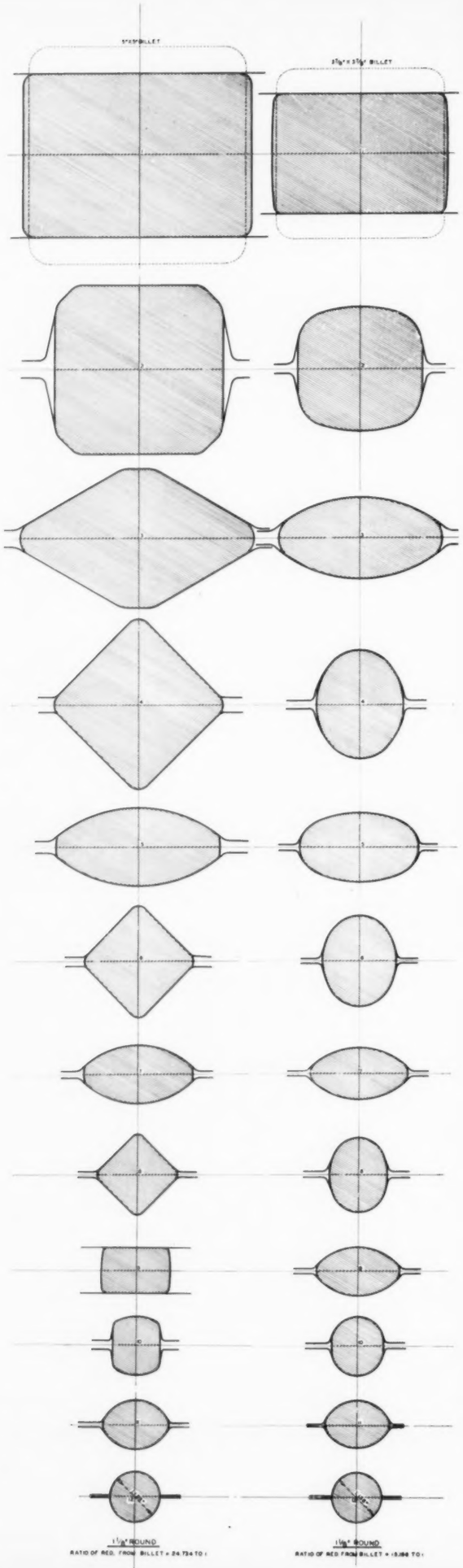
	Per cent
Carbon	3.00-3.15
Manganese	.23- .28
Silicon	.58- .62
Sulphur	.07 max
Phosphorus	.20
Molybdenum	0- .25

Nickel chilled, with ⅞ in. chill, for 14 in. roll

	Per cent
Carbon	2.99-3.05
Manganese	.22- .24
Silicon	.60- .62
Sulphur	.06- .08
Phosphorus	.15- .25
Chromium	.25- .35
Nickel	1.90-2.10
Molybdenum	.30 max

Drawing 33 — Roll molds for bar mills.





Grain roll for 10 *in. mill,* 68-72 *Shore hardness*

	Per cent
Carbon	3.35
Manganese	.35
Silicon	.13- .14
Sulphur	.06 max
Phosphorus	.15
Chromium	1.10-1.20
Nickel	.80-1.00
Molybdenum	.20

Alloy iron for 16 *in. leader roll for* 2-4 *in. rounds*

	Per cent
Carbon	2.10-2.20
Manganese	.30
Silicon	.50
Sulphur	.09- .15
Phosphorus	.25
Chromium	1.00
Nickel	.50-1.25
Molybdenum	.20- .25

Hard alloy for 18½ *in. x* 40 *in. roughing roll*

	Per cent
Carbon	2.20
Manganese	.50
Silicon	.40
Sulphur	.05
Phosphorus	1.03
Chromium	1.05
Nickel	1.54

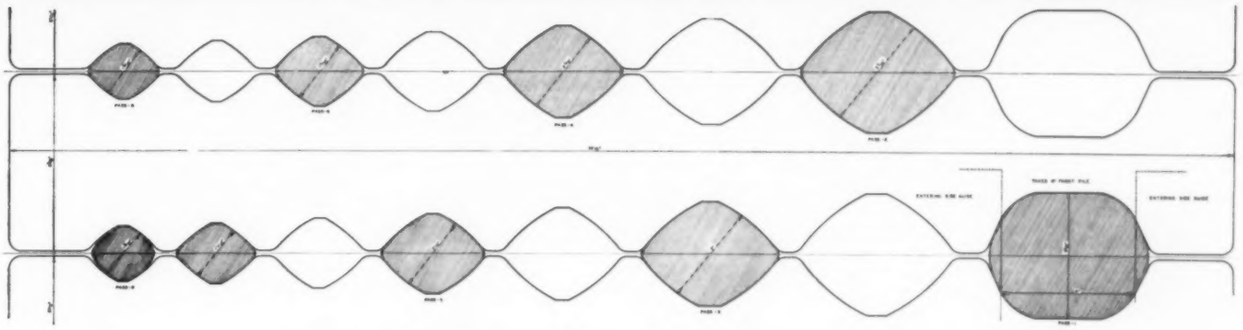
Drawing 33 illustrates three molds used for casting bar mill rolls, showing the several methods used for casting. The full lines show the roll as cast, the dotted lines indicating the finished outline of the roll. Figure 1 represents a chill iron angle finishing roll for use in a 14 in. mill. Figure 2 shows a grain roll having diamond passes for use in a 14 in. strand mill. Figure 3 represents a 14 in. alloy steel roll such as is used in the roughing stand of a hand bar mill. The first two rolls are not heat treated, but the alloy steel roll is treated as follows:

After casting, the roll is shaken out of the mold at 1000 F, put into an annealing furnace and brought up to 1600 F at the rate of 50 degrees per hour. It is held at this temperature for 30 hours and then cooled to 125 F over a period of 80 hours, after which it is taken out of the furnace. The entire treatment takes 122 hours.

BAR MILL ROLL DESIGNING

The bar mill roll designer must have an adequate technical training, together with a considerable background of experience, to do his work successfully. Designing rolls for mills which roll only common steel into the usual bar sizes such as rounds, squares and flats does not require extensive experience nor as close

Drawing 34 — (left) Comparison of standard practice versus special pass formation to eliminate wrinkles.



Drawing 35 — Gothic passes in 9 in. x 36½ in. roughing rolls.

a study as is required when shapes are to be rolled. In the case of intricate shapes, however, considerable ingenuity is required in designing the rolls.

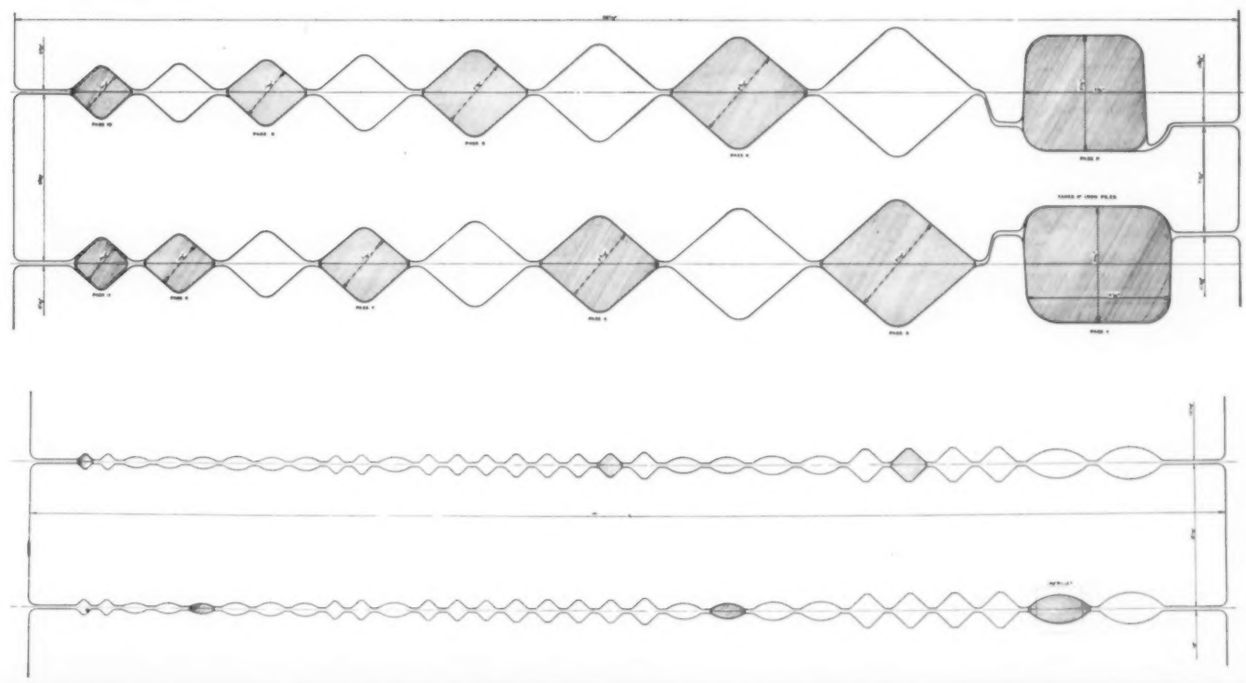
Considerable thought and care must be given to the design of rolls and passes for alloy bar production. Defects sufficient to cause rejection of the product may easily result from improperly designed passes. Proper design of the pass shapes will, however, overcome or minimize the effect of marks and seams resulting from improperly filled passes or from the scale break which develops at the roll openings. This latter condition may result in rolled-in seams or wrinkles of considerable depth and must be carefully guarded against in roll design.

Drawing 34 shows some of the passes used for rolling a 1⅛ in. round. The shapes of the line of passes on the right are such as to prevent the formation of sharply defined scale breaks. Such a form of passes, however, has a low percentage of draft as compared to others now in use and does not have the scale shedding qualities of the oval and square method. The special design shown, however, is very successful in eliminating the rolled-in scale break marks which are sometimes called wrinkles. Also shown on the drawing on the left are the conventional passes used for rolling the same size round, to illustrate the difference in drafting which occurs in the two systems.

Designers of rolls for small shapes are aided by certain factors. One of the most important of these is the fact that the smaller the bar, the more it spreads under drafting. This is in part due to the fact that bars used in rolling small shapes are colder than those used for larger shapes and also to the large ratio existing be-

Drawing 36 — (below top) Box and edge and diamond roughing passes for 9 in. bar mill.

Drawing 37 — (below bottom) 12 in. roughing rolls for 8 in. train.



tween the diameter of the roll as compared to the size of the shape being rolled. It has been found that as the diameter of the roll increases with respect to the size of the shape, the spread also increases.

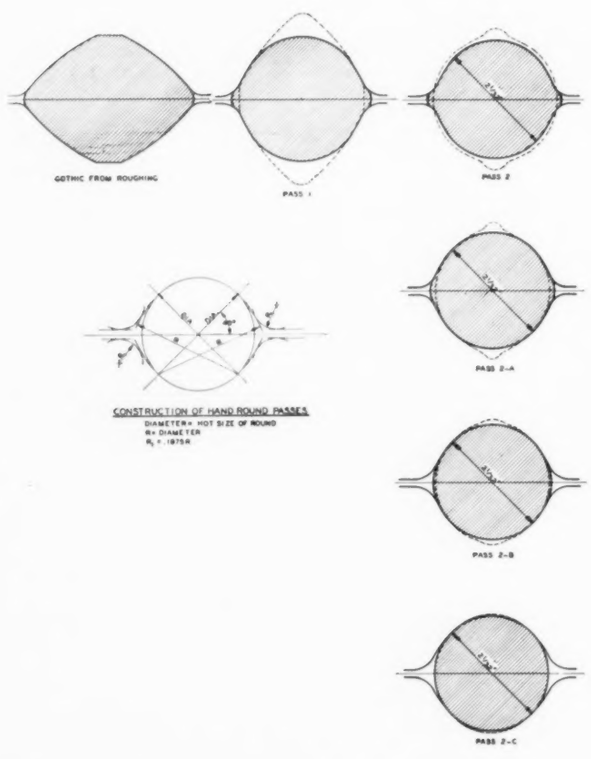
As a result, a small shape can ordinarily be formed in fewer passes than would be required for a large shape. Shapes of intricate design can thus be rolled in small sizes but not in large sizes, because of insufficient roll diameter in the case of the large shape. For example, when a 1 in. square is rolled on a 10 in. mill, the ratio of the bar diameter to the roll diameter is 10:1. If, however, an 8 in. square is rolled on a 28 in. mill, the ratio becomes only 3.5:1.

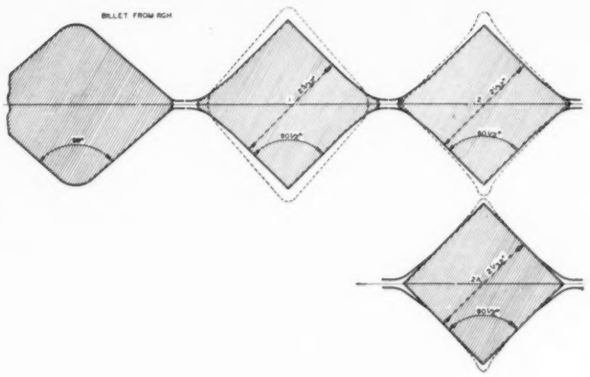
Careful calculation is required in designing rolls for use in continuous roughing mills. Stretching between stands in the roughing passes causes unevenness in the finished sizes, as does also improperly filled passes, indicating certain phases of the problem confronting the roll designer.

One of the earliest forms of grooved roughing passes is the Gothic roughing pass, shown in Drawing 35. Passes such as these were used in simple bar mills such as the one illustrated in Drawing 1. In Drawing 35 the first pass illustrated was designed to take a 4 in. iron fagot pile, while the succeeding Gothic passes reduced it to $1\frac{9}{16}$ in.

Box and edge roughing was another early design. Drawing 36 illustrates combination box and edge and diamond roughing passes as used in a 9 in. mill. The box and edge passes were designed to take a 4 in. iron rail pile, but the design was also suitable for use with the regular iron piles. Oval and square passes became more common when small billets were to be rolled into smaller bar sizes, as greater percentage reductions could be attained when these passes were used. Drawing 37 illustrates the oval and square passes used on 12 in. roughing rolls for an 8 in. train.

Drawing 38 — Hand round rolling.





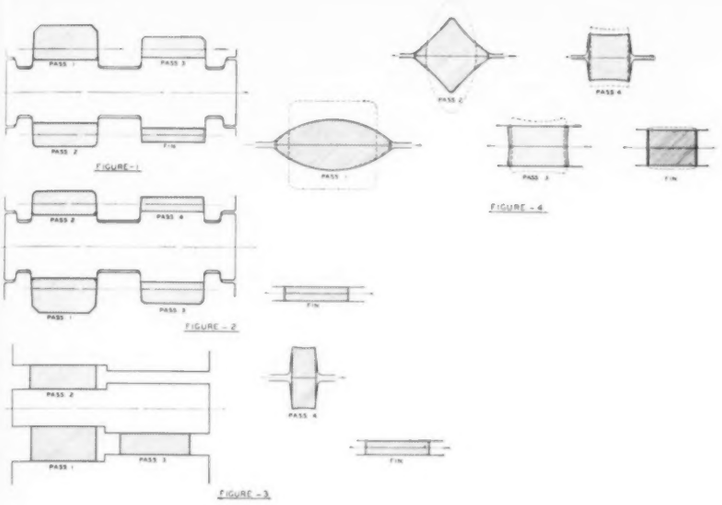
Drawing 39 — 2 in. sharp cornered hand squares.

The next stand following the roughing sequence in the bar mill illustrated in Drawing 1 was called the strand rolls. Strand passes for rolling rounds and squares were almost always oval and square or diamond and square. Flat and edge passes were used for rolling round edge and square edge flats and occasionally for rolling half rounds and half ovals. Tongue and groove rolls were also used for flats, and some flats were rolled in diagonal leader and finishing passes, leader stand passes usually being ovals for rounds, diamonds for squares, or flat edgers for flats.

The last stand in a 4 or 5-stand mill was called the finishing stand and the roll passes used in this stand were turned to produce the hot size section.

Most of the rounds produced on the early type mills are made by the so-called hand-round rolling method. This method ordinarily used two round passes turned in the two-high set of rolls located in the strand mill housing. After each rolling pass the bars were passed back over the top roll by the tongmen and re-entered. The bar was taken from the last roughing pass and then given a single pass through the first round pass, after which it was entered into the second round groove. Here it was given three or four passes, turning the bar 90 degrees each time it went through the pass. This method of rolling was very accurate and produced a good round. Drawing 38 illustrates this method of rolling.

Long lengths could not be rolled successfully by the hand-round method. The finishing rolls were two-high and the length of the bar was limited by the ability of the tongman to handle the bars over the top roll. In addition to this handicap, the roller and catcher had to guide and hold the bar with tongs all the time it was going through the rolls, which was laborious, hard work, increasing in difficulty as the bar grew longer. Soon,



Drawing 40 — Examples of flat rolling for bar mills.

however, it was discovered that an oval could be rolled into a round if held by guides in the finishing pass in such a way as to prevent it from turning down. Introduction of the guide-round method made it possible to roll long lengths, even though the bars were not as accurate in dimension as was possible when using the hand-round method. In guide-round rolling, an oval, somewhat wider and thinner than the finished round, was entered into a dead round pass, being held in proper position in the pass by guides.

Sharp cornered squares were first made in two-high finishing rolls by the same method as was used for hand-rounds, but it was only necessary to send the bar through the finishing pass twice. Drawing 39 illustrates this early method of making sharp cornered squares. When guides were developed, sharp cornered squares were made by entering a diamond section into the square finishing pass, held up by the guides.

Square edge flats were first made by tongue and groove rolls set in the strand mill housing (Figure 1, Drawing 40). Two-high rolls were used at first, three-high sets being used later. As roll design progressed, the smaller sizes were taken from the tongue and groove strand flat rolls, edged in leader rolls, and finally finished flat in the finishing stand (Figure 2). Round-edge flats were made in the same strand rolls, edged in a round edging pass, and finished flat.

A still later development involved taking a square billet from the roughing stands, flatting it in a series of slabbing passes in the strand mill, edging the flat in the leader rolls and finish rolling it flat in the finishing stand as illustrated in Figure 3 of Drawing 40. This method was used for both round edge and square edge flats. Another method, which is still in use, involves taking a fluted square and flatting it once or twice, followed by entering it on edge into a concave edging pass and finally finishing in a flat pass as shown in Figure 4.

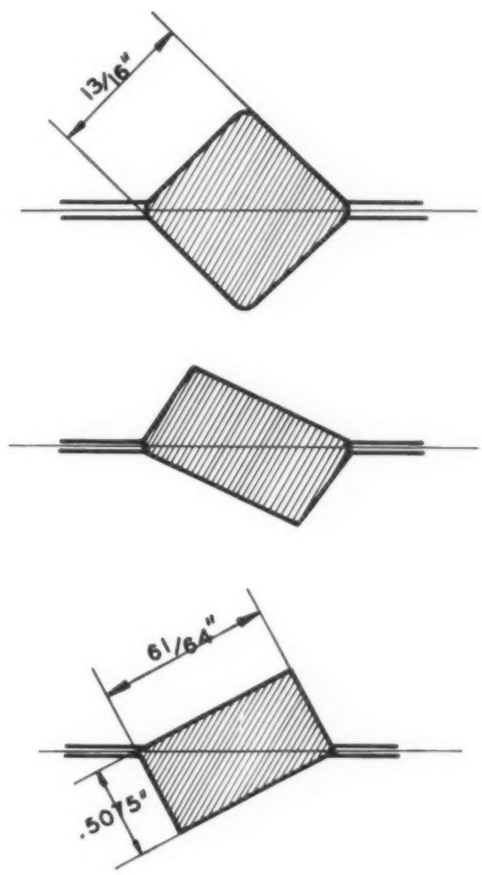
Nut flats were made in diagonal passes. A square was entered directly into a diagonal leader pass and then finished in a diagonal finishing pass as shown in Drawing 41.

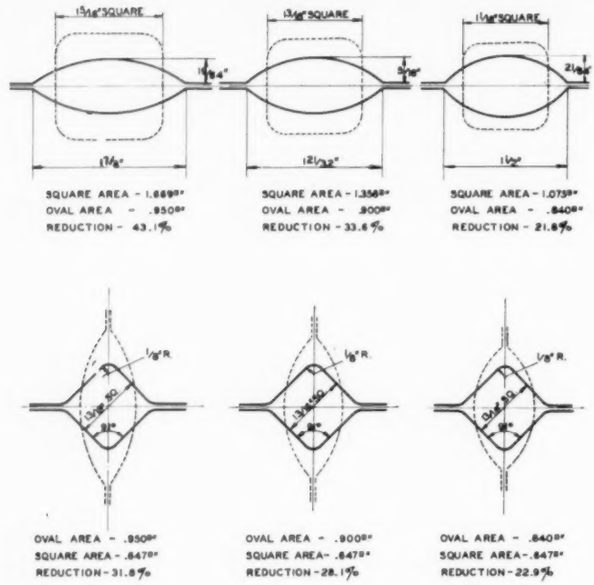
DRAFT

In the early bar mills the amount of draft possible varied with the diameter and speed of the rolls, together with the amount of ragging on the rolls. The speed of the roughing rolls in turn was limited by the ability of the workmen to catch and re-enter the bars.

Draft varied from about $\frac{3}{4}$ in. to $1\frac{1}{4}$ in. for the first two passes, which were usually flat and edge, when working iron piles, these passes being best suited to welding the pile together. Succeeding passes, as previously described, were either gothic or diamond and the degree of angle of these passes regulated the amount of draft, the draft increasing as the angle increased. The angle most commonly used was 98 degrees. When it was necessary to deliver a square section from the roughing train, the bar was roughly squared by passing it twice through the same sized groove in the roughing mill before taking it to the strand mill.

Drawing 41 — $^{15}/_{16}$ in. x $\frac{1}{2}$ in. nut flat design.



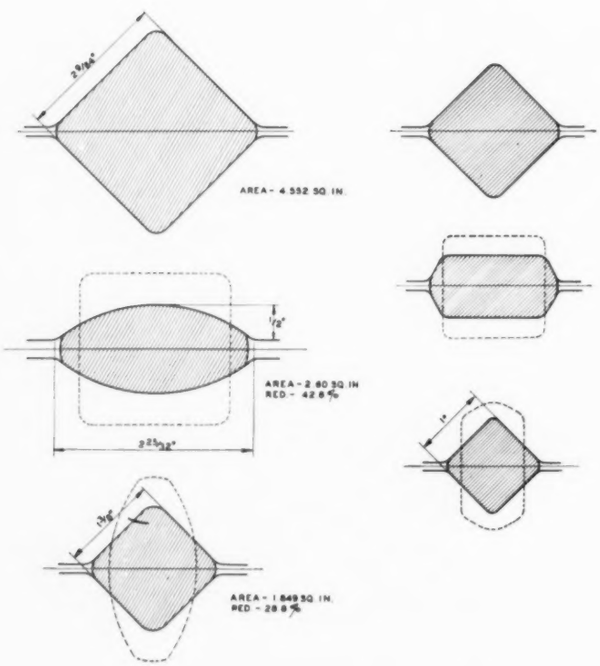

SQUARE AREA - 1.869 sq in
OVAL AREA - .950 sq in
REDUCTION - 43.1%
SQUARE AREA - 1.356 sq in
OVAL AREA - .900 sq in
REDUCTION - 33.6%
SQUARE AREA - 1.075 sq in
OVAL AREA - .840 sq in
REDUCTION - 21.8%
OVAL AREA - .850 sq in
SQUARE AREA - .647 sq in
REDUCTION - 31.8%
OVAL AREA - .900 sq in
SQUARE AREA - .647 sq in
REDUCTION - 28.1%
OVAL AREA - .840 sq in
SQUARE AREA - .647 sq in
REDUCTION - 22.9%

Drawing 42 — (above) Types of ovals for squares.

▲

Drawing 43 — (bottom left) Heavy reduction, square to oval.

Drawing 44 — (bottom right) Flat hexagon breakdown ovals.



The strand mill oval and square pass design depended for its success upon the "biting" ability of the rolls. A very flat oval would give a big reduction, but would cause slipping unless the passes were heavily ragged. Draft from the square to the oval varied from about 22 per cent to about 45 per cent, depending upon the flatness and width of the pass. The percentage reduction attained from ovals to squares ranged from about 22 per cent to 32 per cent according to conditions.

For rolling a square into an oval the most commonly used design provided a draft of approximately 35 per cent, with about 28 per cent when rolling the oval to a square. In these rolls the square passes had an angularity of from 91 to 94 degrees. A good square could be obtained in one pass through a 91 degree square pass, but when a pass of 94 degree angularity was used it was necessary to send the bar through the pass twice in order to get a satisfactory square. Drawing 42 illustrates a sequence of oval and square designs with thin, medium and thick ovals entering a $\frac{15}{16}$ in. square with varying reductions. Drawing 43 shows some actual drafting in the case of a 16 in. mill rolling chrome-molybdenum steel from a $2\frac{9}{64}$ in. square through an oval to a $1\frac{3}{8}$ in. square. In this pass design the draft on the oval is 42.8 per cent and the reduction on the square is 28.8 per cent.

Instead of the strand oval, a flat hexagon pass was frequently used. This style of pass, shown in Drawing 44, provided more draft than did the oval and made it easier to hold the bar in position with the entering guides.

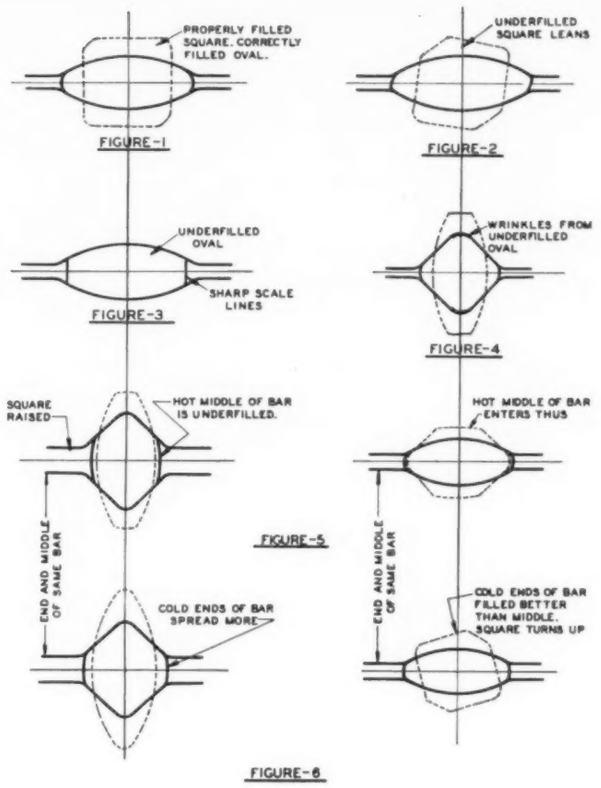
In rolling a round, the draft on the oval leader from the entering square is governed by the flatness of the oval. When rolling iron, which was the principal product in the early days, oval passes were not very flat, with the result that the finishing draft taken on the oval was only about 15 per cent.

Pass design for modern bar mills has become relatively standardized, three principal designs being now in common use. These are known as the oval and square method, the diamond and square method, and the flat and edge method.

OVAL AND SQUARE METHOD

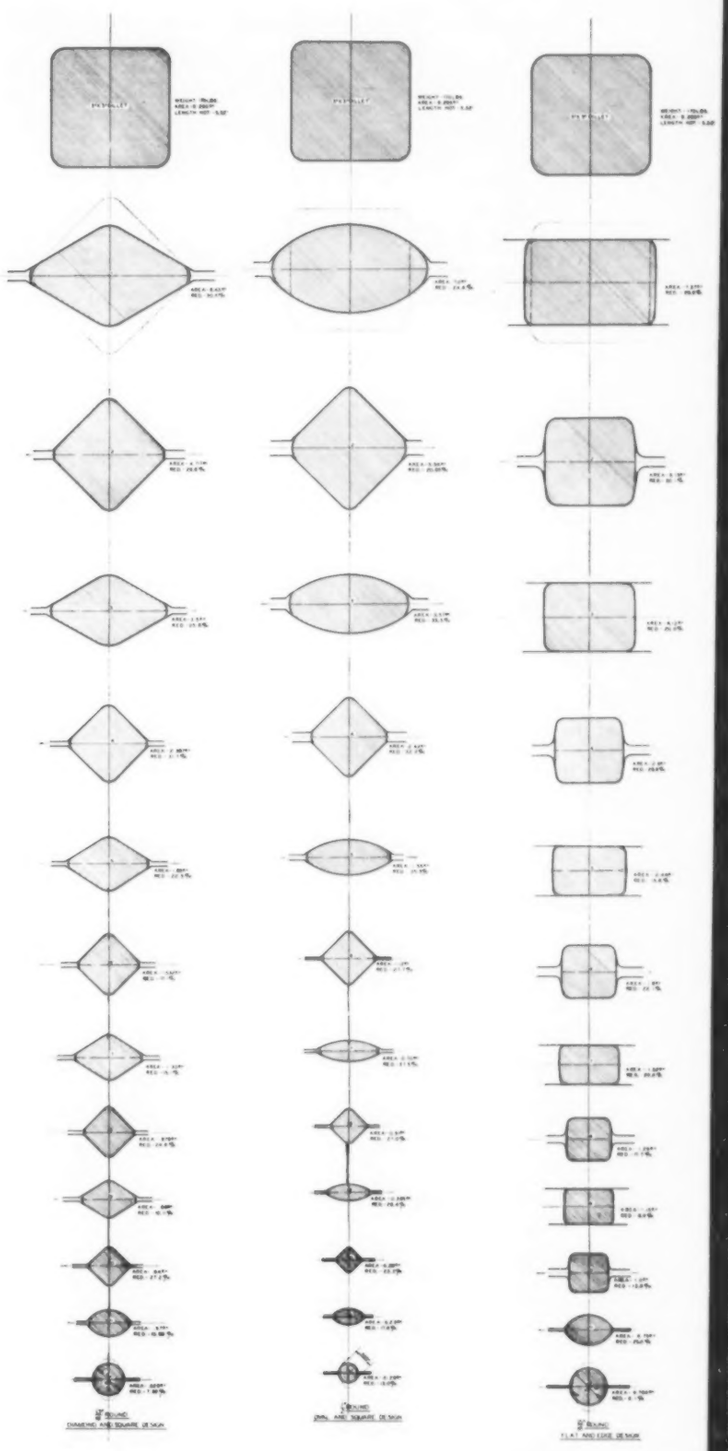
The greatest percentage of reduction is attained by using the oval and square method of rolling and this type of pass design is almost universally used for small and medium sized sections. Good scale breaking and shedding is achieved with this design, as the heavy reduction combined with the turning of the bar after each pass provides a good opportunity for the scale to fall away from the bar.

There is, however, one serious disadvantage to the square and oval method. The shape of the passes, combined with the opportunity for scale to form at the roll opening, gives rise to a condition where the scale break of the oval is pinched in the bottom fillet of the square pass. As a result, lines which are often of considerable depth, show up on the finished bar, sometimes being serious enough to cause rejection of the product.



Drawing 45 — (left) Breakdown oval problems.

Drawing 46 — (below) Comparison of three methods of rolling rounds.



DIAMOND AND SQUARE METHOD

The diamond and square method of rolling is well-known and has the merit of contacting the bar on all four sides, not allowing as much spread as is possible in the other methods. This method is second to the oval and square method in regard to reduction possibilities and it should also be noted that diamond and square pass formations do not get rid of scale as readily as is the case with oval and square passes.

FLAT AND EDGE METHOD

Flat and edge passes are extensively used for rolling the larger bar mill products. This method sheds scale readily as the rolls only contact the top and bottom of the bar at each pass, thus allowing the scale to drop off freely from the sides. Of the three methods discussed, the flat and edge method develops the least reduction in area. One disadvantage in this system of passes is that when an edging pass is completely filled, considerable friction develops between the rolls and the sides of the bar. This condition has an adverse effect upon the finished surface of the bar.

COMPARISON OF ROLLING METHODS

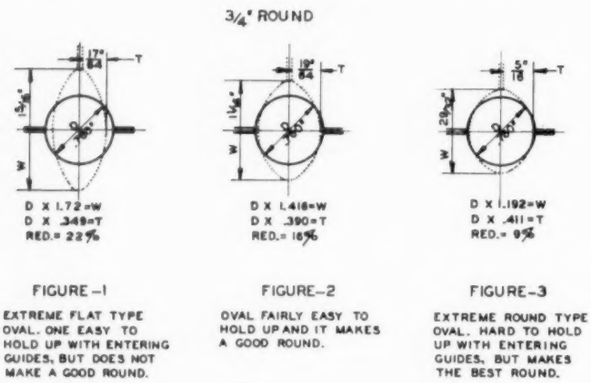
There are some objectionable features to the use of

oval and square passes on continuous roughing mills. When the square passes are raised to produce larger squares, as outlined earlier in this paper, underfilling occurs in both the square and oval passes because of insufficient stock in the entering billet. This underfilled condition of the entering squares causes the square to lean over as it enters the oval, which in turn causes an uneven filling of the oval pass. If the oval is filled to the collar line, a lap will develop on the corners of the succeeding square. Figure 1 in Drawing 45 shows a correctly filled square entering an oval pass, while Figure 2 in the same drawing illustrates what happens when an underfilled square enters the same oval.

A large scale break, as shown in Figure 3, tends to develop when the square does not fill the oval. In the case of some alloy steels, this break is very rough and when the underfilled oval is entered into the succeeding square pass the rough scaly surface will be pinched and crimped into wrinkles. Scale will be trapped in these wrinkles and the finished bar will be badly seamed, as shown in Figure 4.

Rollers sometimes deliberately accentuate the underfilling of both ovals and squares in continuous roughing mills for several reasons. When the last square delivered from a continuous roughing train is to be larger than standard, it is necessary to raise all the rolls in the train. This results in underfilling of the early passes. Underfilling will be most pronounced in the middle of a bar from a 30 ft billet because the steel is hotter in the middle section of the billet than it is at the ends (see Figure 5, left). Thus, being colder, the ends of the bar will spread more and the passes will be better filled on the sides than will be the case at the middle of the bar (Figure 6, left).

In its passage through the train, such a bar will be nearly upright as it starts, leaning over as its middle section comes along, and straightening up again as the



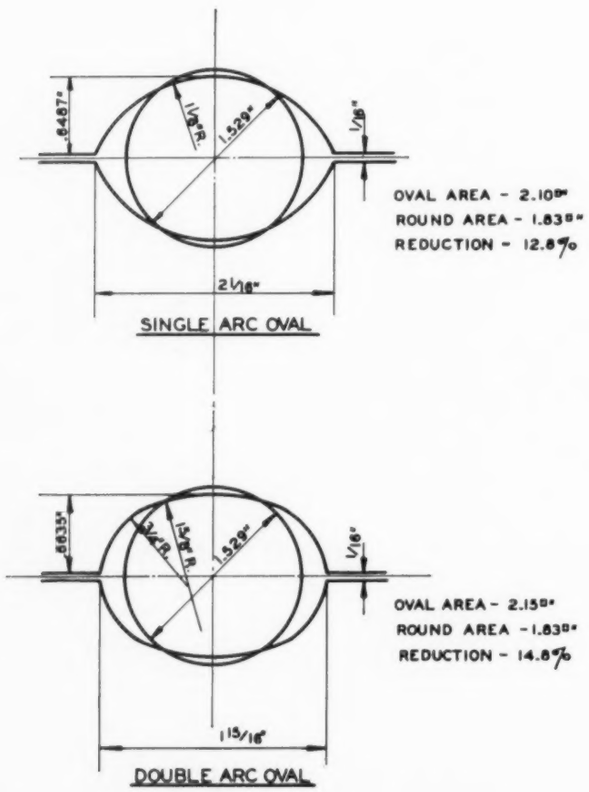
FIGURE–1
EXTREME FLAT TYPE OVAL. ONE EASY TO HOLD UP WITH ENTERING GUIDES, BUT DOES NOT MAKE A GOOD ROUND.

FIGURE–2
OVAL FAIRLY EASY TO HOLD UP AND IT MAKES A GOOD ROUND.

FIGURE–3
EXTREME ROUND TYPE OVAL. HARD TO HOLD UP WITH ENTERING GUIDES, BUT MAKES THE BEST ROUND.

Drawing 47 — (above) Round oval types.

Drawing 48 — (below) Single and double arc ovals for 1½ in. rounds.



Drawing 49 — Ovals and oval formers.

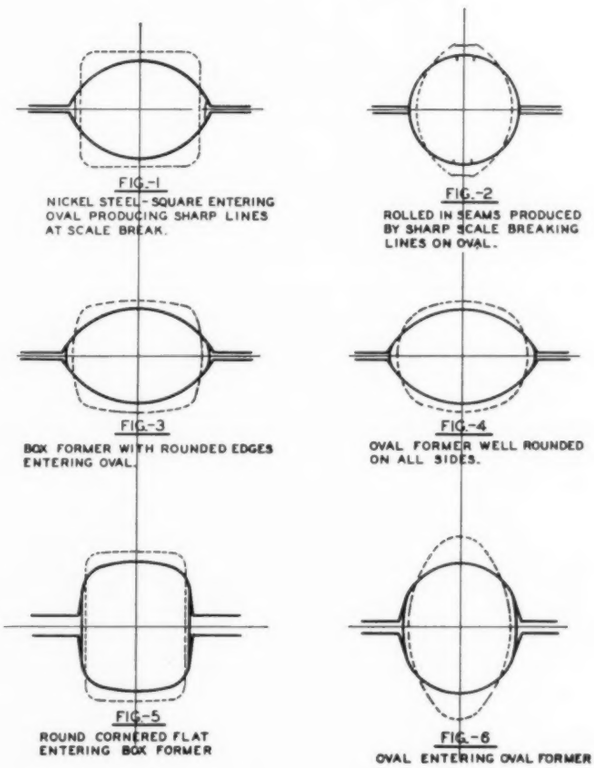


FIG.-1
NICKEL STEEL-SQUARE ENTERING OVAL PRODUCING SHARP LINES AT SCALE BREAK.

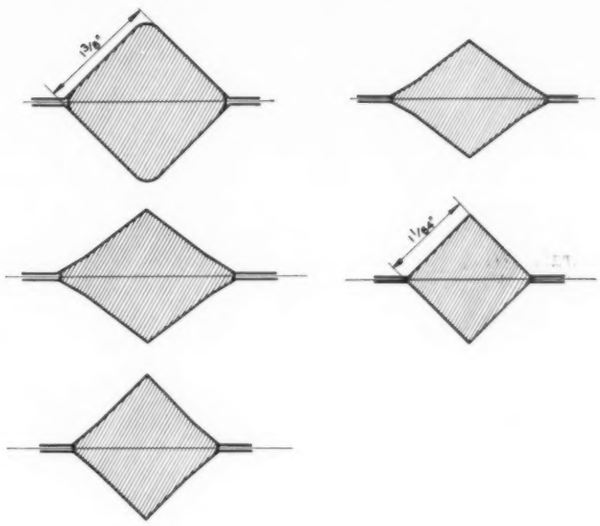
FIG.-2
ROLLED IN SEAMS PRODUCED BY SHARP SCALE BREAKING LINES ON OVAL.

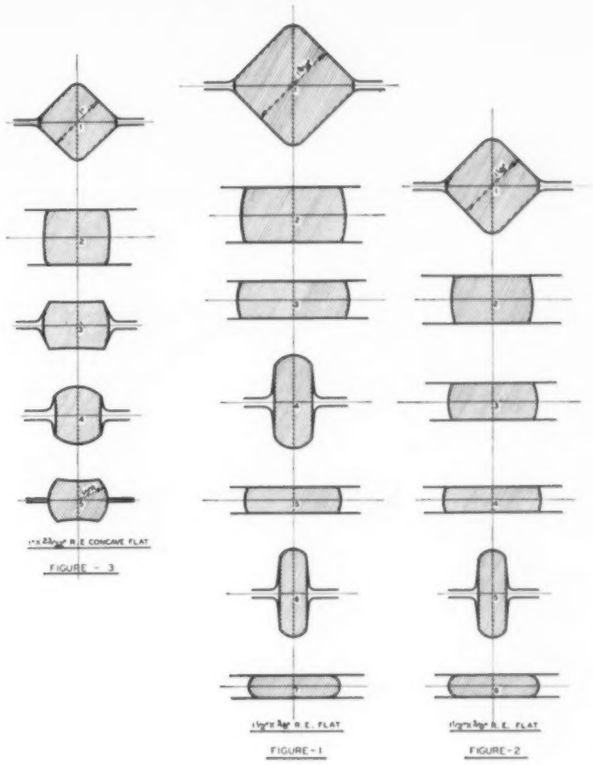
FIG.-3
BOX FORMER WITH ROUNDED EDGES ENTERING OVAL.

FIG.-4
OVAL FORMER WELL ROUNDED ON ALL SIDES.

FIG.-5
ROUND CORNERED FLAT ENTERING BOX FORMER

FIG.-6
OVAL ENTERING OVAL FORMER





Drawing 50 — (above) 1 in. sharp corner square.

Drawing 51 — (right) Round edge flat design.

Drawing 52 — (bottom right) Two methods of rolling hexagons.

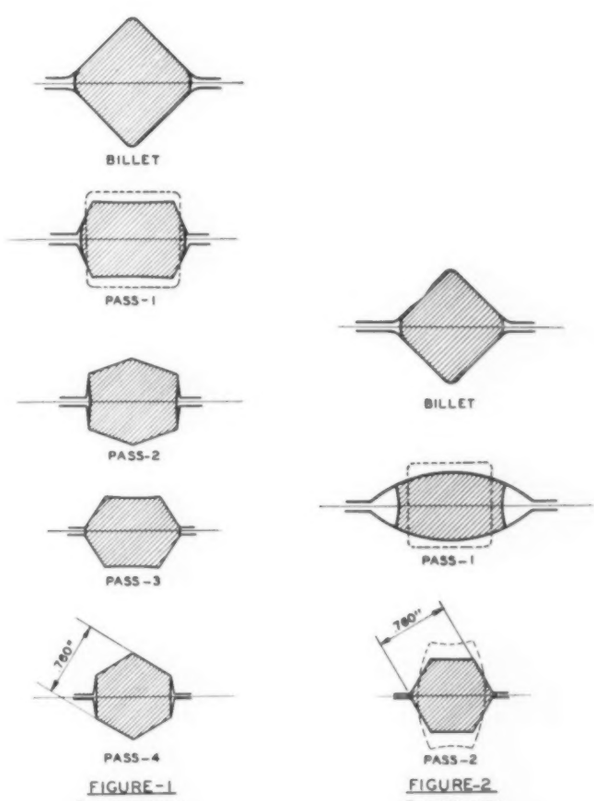
end approaches. By raising the square pass rolls excessively, the roller will cause the square to be underfilled in the middle to such an extent that it will lean so far over that the corners of the square will be in the opening of the oval passes. By doing this, the roller makes sure that the oval will be completely filled even at the middle of the bar, as illustrated by Figure 5, right. The colder ends will more nearly approximate a square in section and will enter the oval pass in a more nearly upright position, as shown in Figure 6, right.

The result of this maneuver is a bar more nearly uniform in cross section throughout its entire length than would be possible had the rolls been raised only slightly. This is not good practice, but is an expedient often used by rollers on bar mills having continuous roughing trains.

Diamond and square passes are usually used for breaking down medium sized bars, although they may be used for rolling sizes as large as 8 in. x 8 in.

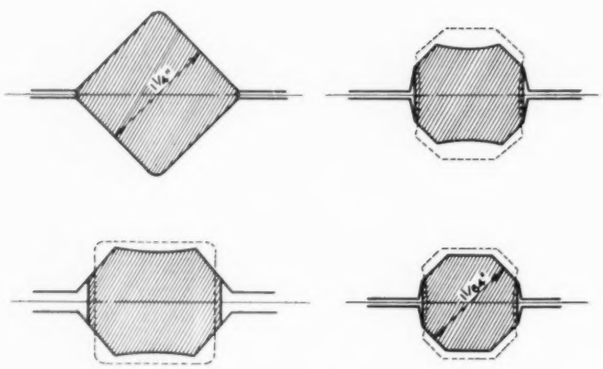
Flat and edge passes are almost exclusively used for medium and large sizes, this method being rather impractical for the smaller sizes.

Drawing 46 illustrates the difference in draft which occurs in rolling three different sizes of round through the same number of passes by the three methods discussed. The same sized billet is used in each instance.



LEADER AND FINISHING PASSES

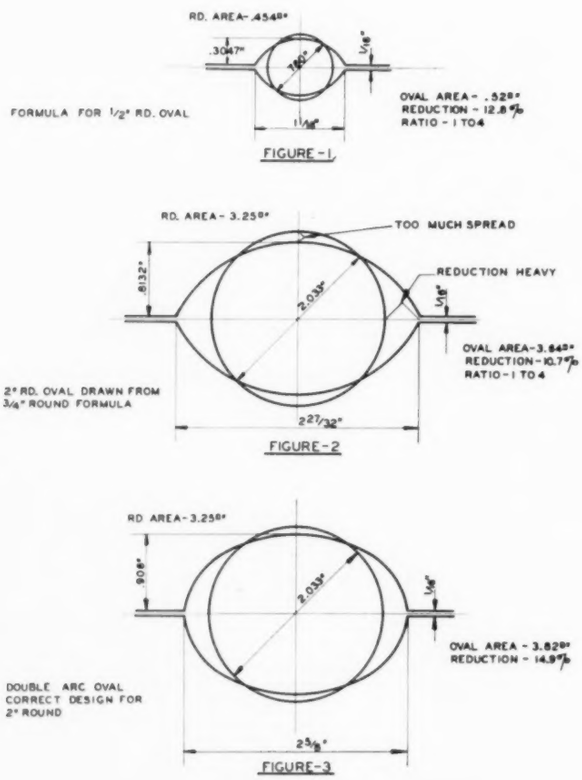
Finishing passes for rounds, squares and flats are relatively easy to design and cut. These passes are made somewhat larger than the cold finished size, allowance being made for the shrinkage of the bar after it leaves the finishing pass. If a dead cold size is desired, the shrinkage allowed for will vary from .012 in. to .018 in. per inch of section, depending upon the size of the bar, tolerance, and the finishing temperature.



Drawing 53 — Octagon passes.

▲

Drawing 54 — Formula variations ovals for rounds.



Leader passes for rounds are designed with several purposes in mind. One of the most important factors is the degree of accuracy desired in the finished size and it should be noted that the more nearly the contour of the oval pass approaches that of the finished round, the better will be the round. As the oval becomes flatter, the round likewise tends to decrease in dimensional accuracy. This is explained by the amount of spread produced by the draft, spread being proportional to draft. Where there is little draft there is little spread. Thus, there is very little chance of variation in size in the finishing pass when its draft from the oval is small. The contrary, however, is true when a larger oval and a larger draft is used.

An oval with little draft is very close to a round and consequently is rather difficult to hold in position when entering the finishing pass. The bigger and flatter oval, however, is easier to hold up. The entering guides can therefore be set more loosely, thereby reducing the danger of scratching the bar. A compromise between the two extremes makes a good design.

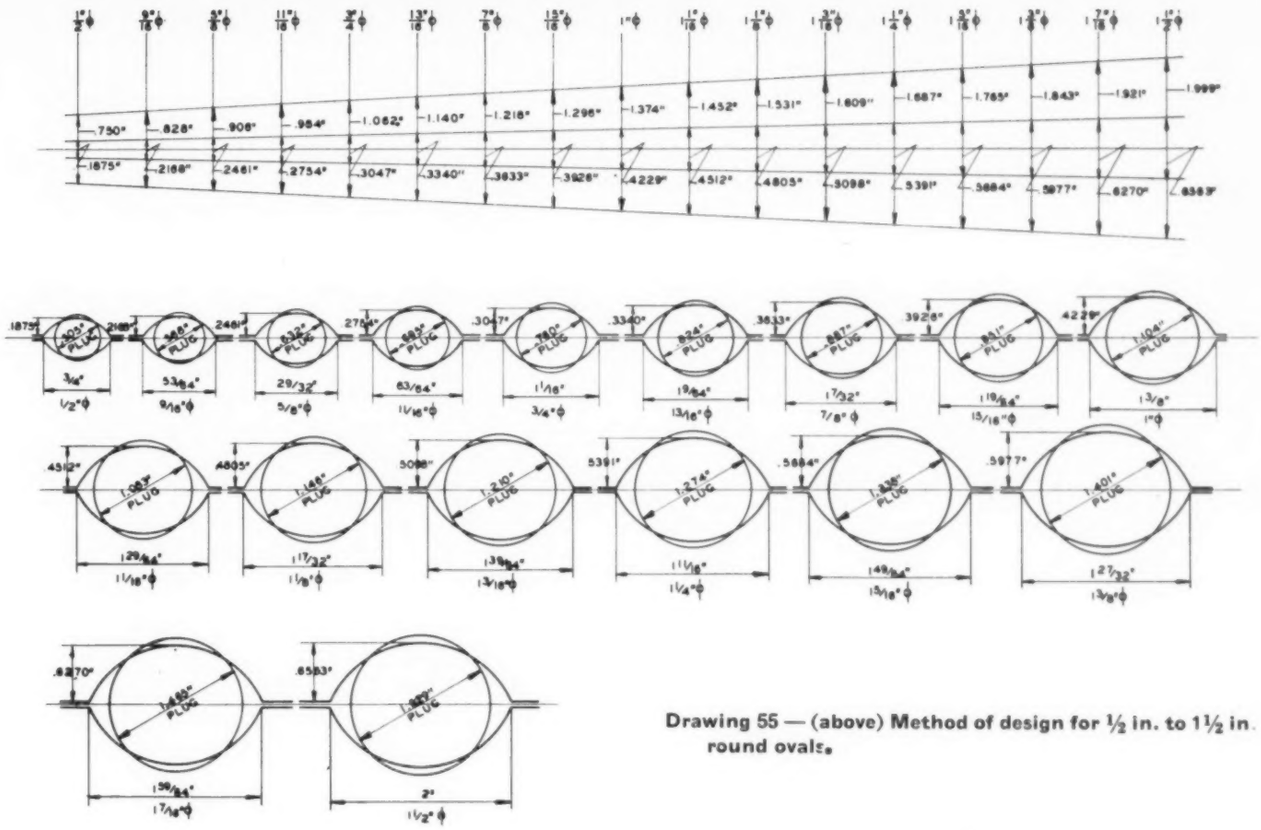
Drawing 47 illustrates the two extremes discussed above, and an acceptable compromise in Figure 2 in the center in pass design for finishing a round from an oval.

The oval used for rolling the smaller rounds is usually that termed a single-arc oval. That is, the oval is drawn with only one radius. Medium and large sized rounds, however, are usually rolled with what is known as the double-arc oval because stock rolled with a single arc oval is too high in the larger sizes to enter the round pass properly as the rolls are not able to "bite" effectively.

A double-arc oval is a fairly wide oval as drawn by a single arc, but modified by a second arc struck with a shorter radius so as to cut down the width. This gives an oval which is flat enough on the sides to permit the guides to hold it up without being too tight, yet one that is not too high to afford a good "bite." Drawing 48 illustrates both single and double-arc ovals designed for the same size round.

Squares were used at first as the section to enter the round oval, and for sizes up to 1 in. the square is fairly satisfactory. In entering the larger sizes of round oval, the square does not completely fill the oval at all points along the length of the bar, for if the oval was filled at the middle, or hottest section of the bar, the colder ends of the bar would overfill and lap. Figure 1, Drawing 49, illustrates the scale break that occurs on the sides at the middle of the bar. On some grades of steel, particularly those high in chromium and nickel, this break is heavily encrusted with scale. An oval of this material, when rolled into a round, from a square, will show four perceptible seams, as indicated in Figure 2. These seams are produced by the sharply defined lines at the junction of the scale break with the radius of the round.

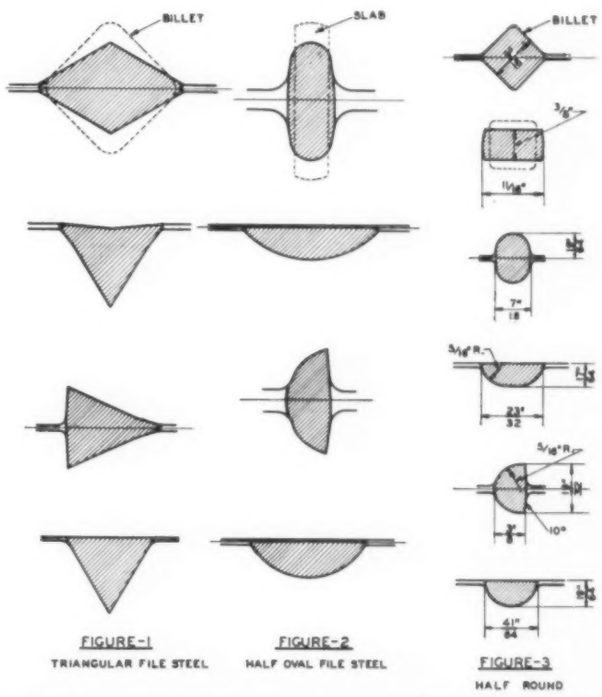
For round sizes larger than 1 in., a pass section known as a "former" gives better results when entered into the oval pass than does a square section. Figures 3 to 6 in Drawing 49 illustrate various types of former passes.



Drawing 55 — (above) Method of design for ½ in. to 1½ in. round ovals.

▲

Drawing 56 — (below) Bar mill sections.

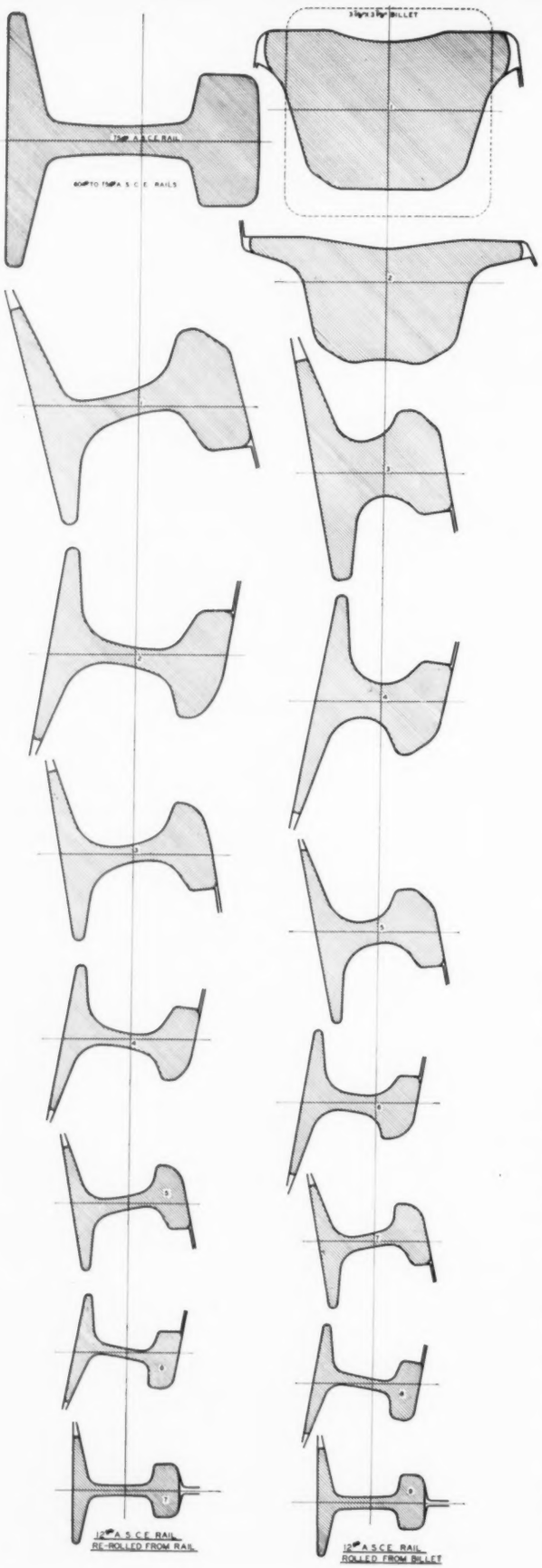


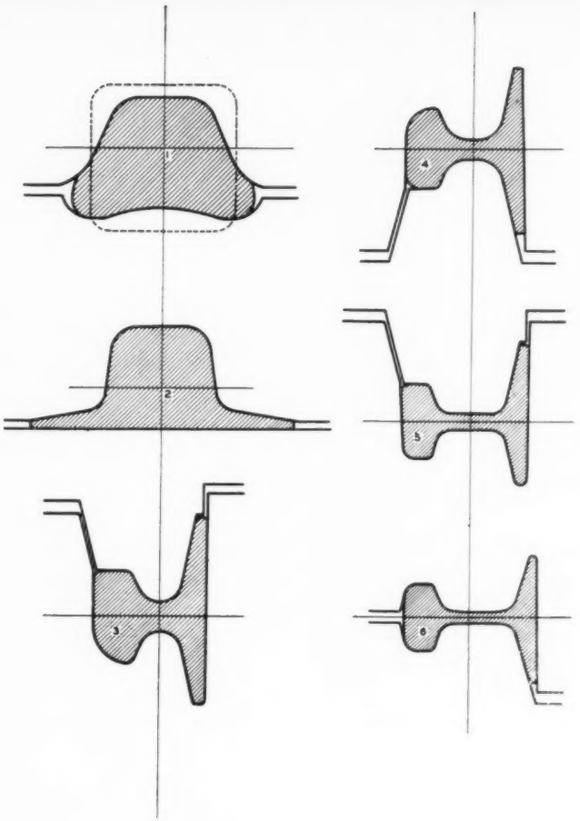
The shape of the box pass former for round ovals (Figure 3) prevents the formation of a sharply defined line at the junction of the scale break with the radius of the oval. Rounding of the oval at this point avoids the likelihood of rolled-in seams. Figure 4 shows another former which is still better as it is rounded on all sides.

In the case of the former shown in Figure 5, a round-cornered flat is entered, while an oval is entered into the former illustrated in Figure 6. Closer tolerances throughout the bar can be maintained in this last case than are possible with either the square or box former passes because of the completely rounded profiles of the passes.

The same principles that hold good in the case of single-arc oval passes for making rounds hold good in the case of diamond passes for making finished squares. Too flat a leading diamond pass will not make as good a square as will be the case when the diamond pass closely approaches the square in contour. Drawing 50 illustrates some diamond passes designed to produce a sharp cornered square.

Leaders for rolling flats are usually edging passes and are fairly simple. Drafts on the finisher, which is a flat pass, range from $\frac{1}{32}$ in. to as high as ¼ in. and the leader pass must have a concavity on the edge to suit the draft so that on a square edged flat the finished bar will be square edged. On a round edged flat, produced





Drawing 57 — (left) Twelve pound rail designs.

Drawing 58 — (above) Eight pound rail rolled on 8 in. bar mill.

from a round edge leader having a larger edge radius than the finished size, the radii on the side of the finished bar will be correct if the proper draft is used in the finishing pass.

Drawing 51 illustrates three methods of rolling round edge flats. Figure 1 represents a sequence of passes utilizing two round edge passes for a round edge flat. Figure 2 shows how the same flat can be rolled using only a single round edge leader pass. Figure 3 shows a special design round edge flat having a concavity on the flat sides. This requires the use of a grooved finishing pass because the tolerance is tight and the radius of the edge must be exact.

Hexagons are often made on bar mills and the two methods of finishing them are shown in Drawing 52. Figure 1 represents the best practice, as the corners are all in the roll, and is the method usually used. Figure 2 illustrates a method in which an underfilled oval is entered directly into the finishing pass. It is, however, almost impossible to make sure that the sharp corner will come at the roll parting because of the size of this opening and the difference in spread of the bar at its front end, middle, and back end. One solution of this difficulty is to install vertical edging rolls after the finishing pass and deliberately over-roll at this point,

relying upon the vertical rolls to correct the overfill.

Octagons are occasionally rolled on bar mills and Drawing 53 illustrates an octagon pass design.

FORMULAE

Various formulae for simple bar mill passes have been developed from time to time to assist the roll designer in his work and to aid beginners in solving their problems. These formulae, however, are only accurate for the particular sizes for which they were developed. For example, a formula for the size of a leader single-arc oval pass to be used in rolling ¾ in. rounds would be inaccurate if applied to a 2 in. round. This condition is illustrated in Drawing 54. Figure 1 at top shows the correct application of the formula. Figure 2 illustrates the mistakes that would occur if the ¾ in. formula was applied to a 2 in. round, while Figure 3 shows a correctly designed 2 in. double-arc round oval. Thus it will be seen that formulae are not particularly useful in actual practice, as they must be changed to suit the sizes under consideration.

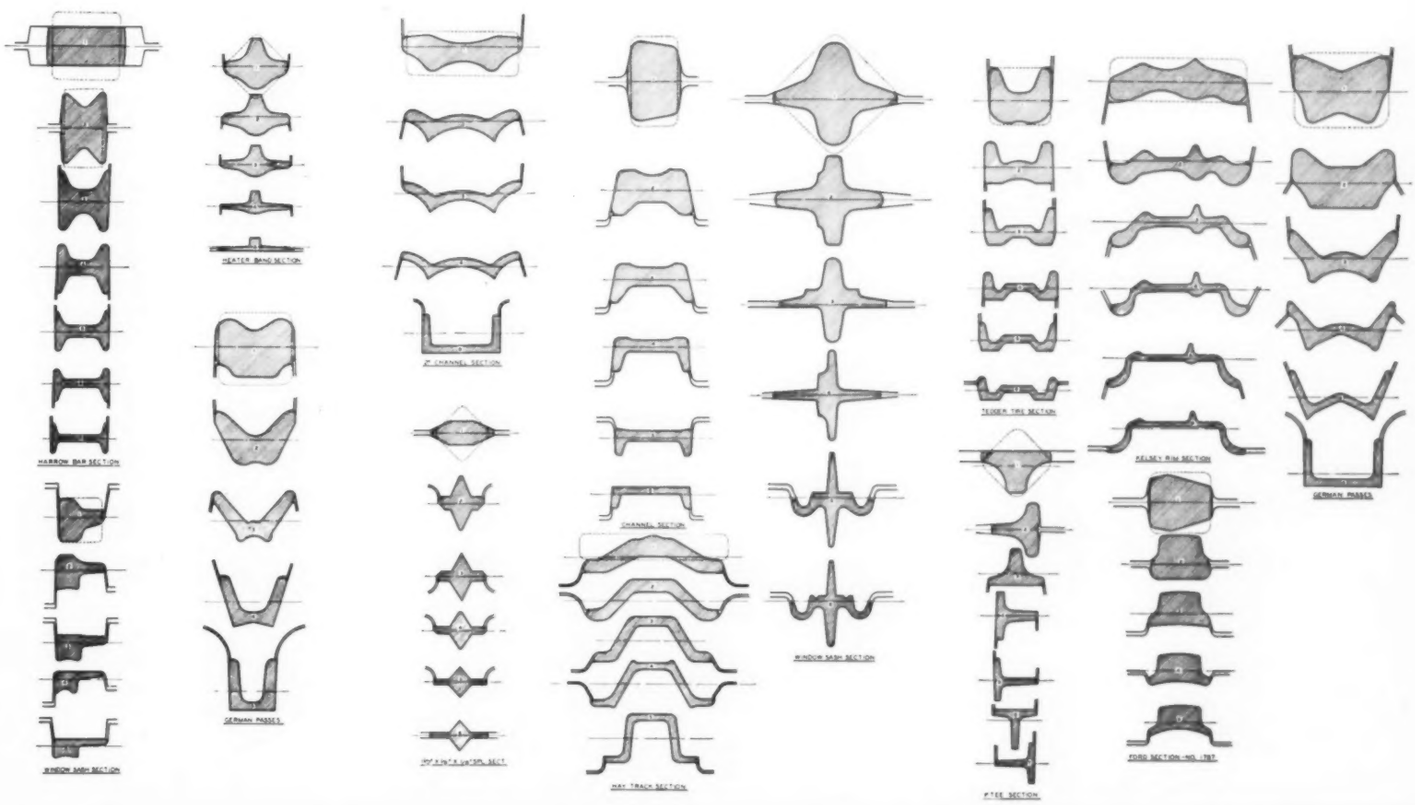
Drawing 55 illustrates a practical way to determine quickly the size of a series of finishing ovals for rounds. The sizes illustrated are developed as follows, the problem being to determine a series of sizes varying by 1/16 in. each from ½ in. to 1½ in. First, develop the dimensions for a practical oval for ½ in. rounds, together with those for a 1½ in. round oval. One diagram will give both the width of the oval and its thickness. Draw a horizontal straight line and divide it evenly into spaces, each division representing a desired size of round. At one end of the line, the width and thickness of the ½ in. round oval are established on a vertical line, evenly spaced above and below the horizontal base line. At the other end of the base line, the dimensions of the 1½ in. round oval are erected. Top and bottom lines are then drawn to connect the oval width points established for the ½ in. and 1½ in. lines, two other lines between these two being drawn to connect the points establishing the thickness of the oval passes for these two rounds. Vertical lines at the division points previously established on the horizontal line, representing 1/16 in. intervals, will then give the width (between the two outer lines) and thickness (between the two inner lines) for each oval size and each will be in the proportion suited to its size.

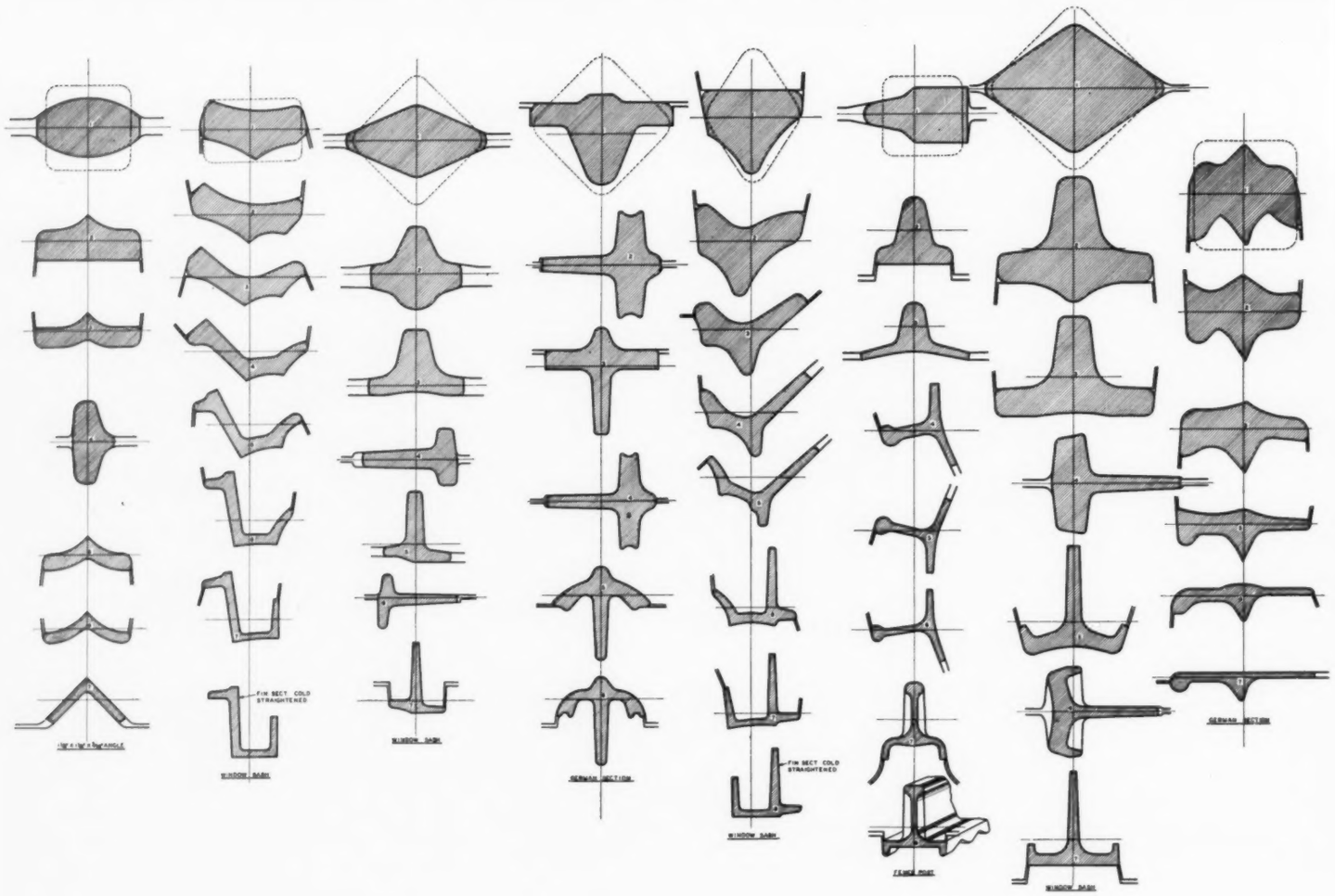
The same method may be used for designing passes for diamonds and squares and also for breakdown ovals and squares.

SMALL SECTIONS

Half rounds and half ovals represent bar mill products used for various purposes, including files. File steel

Drawing 59 — Sections rolled on bar mills.





Drawing 60 — Sections rolled on bar mills.

is also frequently rolled in a triangular section. Drawing 56 illustrates how these three sections are rolled.

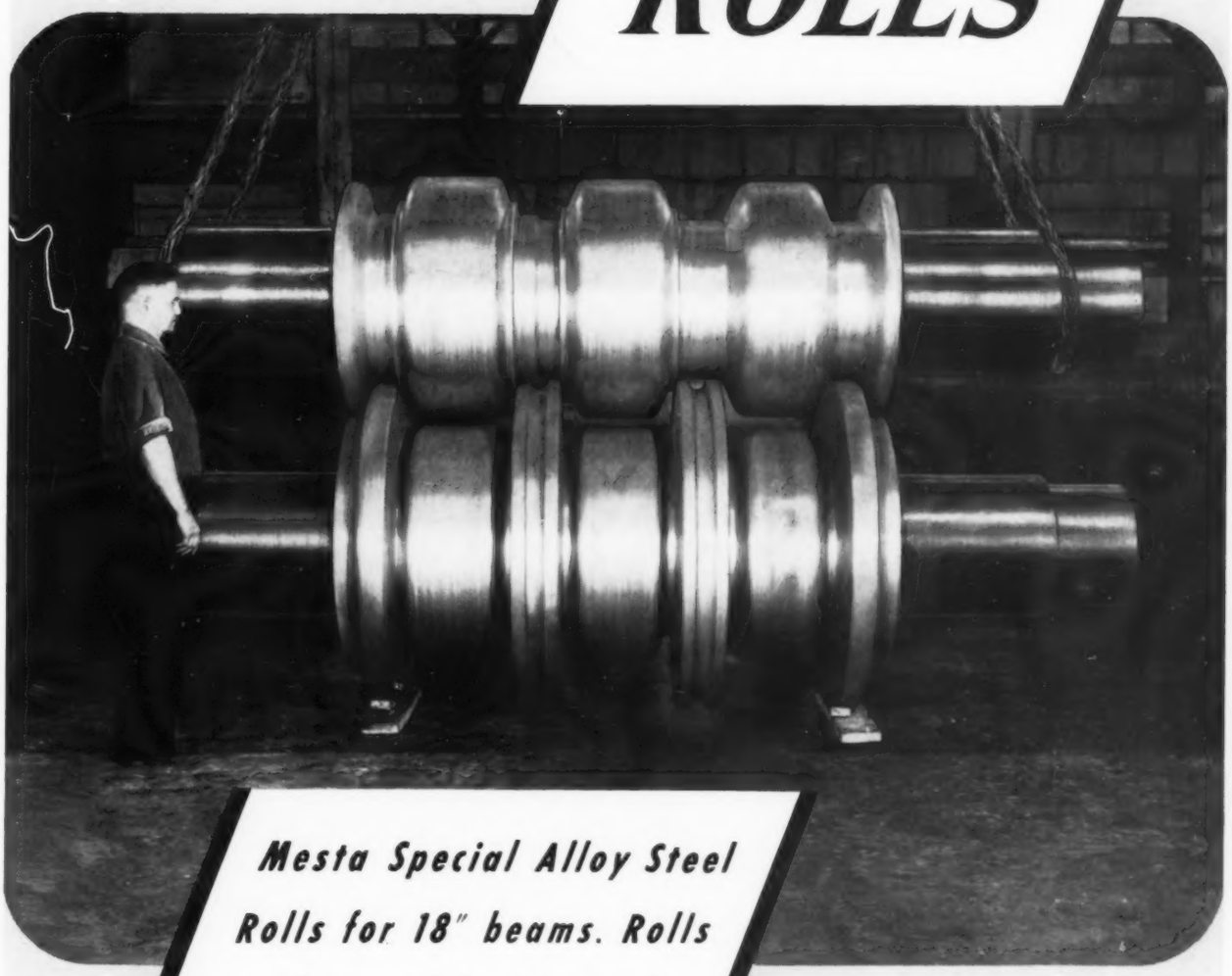
A great variety of sections are rolled on bar mills of various kinds, hand mills of the simpler designs being particularly well adapted to the purpose, as rolling is not continuous. Mills having continuous roughing trains and repeaters are not well adapted to rolling shaped sections because of the difficulties involved in making draft arrangements to suit the section contours. Ordinarily, sections are not designed to provide for the definite ratio of elongation between passes that is necessary when continuous mills are used.

Small angles, channels, tees and even some small sized beams are commonly rolled on bar mills. Instances are known where rails weighing 25 pounds per yard have been rolled on a four-stand 9 in. bar mill similar to the one illustrated in Drawing 1. A Western 12 in. bar mill has rolled rails as heavy as 45 pounds per yard.

Drawing 57 shows two different sets of diagonal pass designs for 12 pound rails as rolled on a 20 in. bar mill. The upper set of passes are designed to roll a 12 pound A. S. C. E. rail from a steel billet, while the lower set illustrates how the same section can be re-rolled from a 75 pound rail. Re-rolling of old rails was common practice when old rails were cheap and in some plants seconds from the large rail mills were converted into small rails as a regular procedure. Drawing 58 shows the six passes involved in rolling an 8 pound rail from a $1\frac{3}{4}$ in. billet on a simple 4-stand 8 in. bar mill.

It is not possible to discuss in detail the design of every section that can be rolled on bar mills as this paper is intended merely to give a general picture of the whole subject of bar mills and bar mill roll design to those who are not thoroughly familiar with the history and progress of this kind of mill. Drawings 59 and 60 have been added to illustrate a number of representative bar mill shapes not discussed in the paper and to show most of the passes required to shape them.

MESTA ROLLS



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* * * *

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. . . . the war-time scarcity of rubber has given impetus to the synthetic insulations for cables, which in certain applications seem superior to natural rubber . . . .

by S. J. Rosch, MANAGER
INSULATED PRODUCTS DEVELOPMENT
ANACONDA WIRE AND CABLE COMPANY
NEW YORK, NEW YORK

▲ LITTLE did we realize in September 1937, when we presented our original paper* entitled "Selection of Insulated Cables for Steel Mills," that within a period of six years the world would be engulfed in another war, but this time of global proportions. Little did we know that many of the materials then plentifully available would completely disappear from our industry and that the user of electrical wires and cables would not only have to accustom himself to a new line of products but would also have to acquire a new vocabulary concerning the insulating materials to be used in the manufacture of these products. Little did we then realize, that within the space of only six years we would reach a period, when copper would be more difficult to obtain than gold and silver, or that before one could purchase an insulated copper conductor, it would be necessary to first run the gauntlet of a C.M.P. and a W.P.B.

Our paper of six years ago, was designed to bring you up-to-date on the latest materials then available. In spite of this, those who still have copies of that paper will find little mention of synthetic resins or synthetic rubber. Most of these were still in the test-tube stage and where available, the price was usually prohibitive for any of the usual installation conditions. Neoprene had just established itself in the field, not as a substitute for rubber but rather as an entirely new material, having properties not generally found in vulcanized rubber. The synthetic resins and synthetic rubbers used in the production of the cables of today, were generally unknown in the parlance of industry and only existed in the technical and patent literature or as a topic of discussion and conjecture on the lecture platforms of scientific bodies.

One might almost be tempted to venture the observation that it is a travesty on modern civilization when many of these scientific miracles had to wait for the present war, in order that they might be given favorable recognition by the public. We have ventured to term these synthetic resins and rubbers as miracles and miracles indeed they are. As a matter of fact, the author of Aladdin and His Lamp or of the entire Arabian Nights was a novice in the field of imagination when considered in the light of the miracles being performed in the production of some of the synthetic materials, whose practical application to wires and cables we intend to discuss in subsequent portions of this paper.

Miracles? Well, just consider the following.

As a by-product of petroleum refining, one of the gases obtained is known as "ethylene," which is one of the most versatile materials in the world.

Ethylene is one of the finest anaesthetics used both by doctor and dentist.

Thirty cents worth of ethylene gas will ripen a carload of green bananas and have them ready for the market upon arrival.

The seeds of potatoes when treated with ethylene gas, will not only increase the growth of potatoes by 100 per cent but will also give them a greater vitamin C content.

Ethylene subjected to extremely high pressures produces polythene, also known in this country as polyethylene, a resin whose electrical and physical properties are so outstanding as to make it one of the most

* A. I. S. E. Yearbook 1938, page 341

important insulating materials the world has ever known. The success of our armed forces will be due in no small measure to the efficiency of these insulations but the entire story can only be told after the war is over. In the postwar period, these materials may prove an important asset in the success of commercial television.

From ethylene, a gas, and benzene (such as used in removing stains from clothing), is produced a resin known as styrene. Styrene mixed with another gas known as butadiene produces the synthetic rubber known as Buna S.

From ethylene, we get a new synthetic resin known as vinylidene chloride known by the trade name "Saran." This resin is used today in the production of non-metallic pipes and valves, chiefly for the chemical industry, as a substitute for the more strategic materials, brass, copper and other metals needed for war purposes.

From ethylene, a gas, we obtain ethyl alcohol similar to the grain alcohol used in making the various concoctions served during the cocktail hour.

Ethylene can be converted into a material known as ethylene dichloride which when blended with other chemicals produces a very valuable synthetic rubber known as thiokol. Many of the leakproof gasoline tanks are made from this material and when the war is over and our boys come home, many an aviator and his crew will owe their lives to the excellent solvent resistance of thiokol to gasoline and other petroleum derivatives.

This same ethylene dichloride however, can also be converted into a resin known as vinyl chloride known by the trade names of Koroseal and Vinylite, so versatile and valuable to the cable industry; but more of this later.

Ethylene gas can also be converted into a material known as acrylonitile. The products made from this material in combination with others, would form a chapter more thrilling than anything in the exciting tales of a Jules Verne or Buck Rogers. It is sufficient however to point out that when acrylonitile is mixed with butadiene, we obtain another very valuable synthetic rubber known as Buna N.

If, for some reason, we cannot obtain ethylene from petroleum, it can quite readily be produced from natural gas or from plain ordinary grain alcohol.

Acetylene is another gas whose modern uses are a far cry from the acetylene lamps used on bicycles and in the household in the early days of this century. Acetylene is made from lime, coal and water and today, its derivative would fill a rather substantial volume. Of greater interest to the scope of the present paper is the fact that from acetylene we produce Neoprene, a synthetic rubber; butadiene for making Buna S or Buna N synthetic rubbers; the synthetic resins known as Koroseal and Vinylite; synthetic resins used in making coatings for magnet wire with exceptional physical and electrical properties; or certain types of carbon black whose electrical conductivity lends itself admirably to the production of conducting rubbers designed to eliminate the formation of static on various mechanical rubber goods, or as de-icers for aircraft floating 40,000 ft above sea level.

Ever since the War Production Board announced its production program for synthetic rubber, our daily newspapers and magazines have been filled with the magic name of butadiene. What is it and from what materials is it produced? The newspapers, magazines and even the Congressional Record have told us that butadiene can be produced as a by-product of petroleum refining or from grain alcohol. That however is not the entire story. Butadiene is a gas when kept at a temperature above 5 C (41 F). Below that temperature it becomes a liquid. In addition to refinery gas and grain alcohol, butadiene can be produced from acetylene gas, molasses, potatoes, sugar, wood, coal tar or natural gas. Different countries have chosen different materials, depending upon their geographical availability and price.

Does it make any difference in the finished synthetic rubber as to the material from which the butadiene originates? To make sure that it does not, all of the butadiene is purified by passing it through a chemical known as furfural. What is furfural? The next time your breakfast consists of a bowl of oatmeal, you might reflect upon the fact that the original oat had a hull which was removed because it is inedible. This hull was formerly thrown away but today, an entire series of resins known as the furfurals, varying in consistency from a liquid to a solid, are made from these hulls. The cheapness of furfural accounts in no small measure for the low price of the Buna S rubber.

The next time you take a bath, look at the cake of soap in your hand with admiration and respect. Why? Because it performs one of the most important functions in the production of Buna S rubber. It is the emulsifying agent found necessary to properly introduce butadiene to styrene, in a common activating tank.

We are not through with our miracles as yet. We have just finished combining the butadiene and styrene in the presence of a soapy solution and we now have Buna S rubber but in the form of a viscous liquid more commonly known as latex. In order to use it on cables as insulation or jacket, this liquid must be coagulated into a solid. The best coagulant is ordinary table salt (the same that you use when seasoning your food), combined with sulphuric acid.

Probably the greatest miracle of all is the fact that the various reactions enumerated, and their number is legion, are carried out under high pressures and in the presence of catalysts. It is these catalysts that are the real miracle of modern chemical magic, because without their presence the reactions could not take place but once the reaction has been completed, the catalyst is removed and search as you may, not a trace of it remains in the finished product. What are some of these catalysts? Copper, nickel, cadmium, zinc, iron, peroxide, phosphoric acid, are but a few of the vast number that could be listed.

Many of these miracles owe their very existence to the miracles performed by the steel industry in turning out the special alloys, the stainless steels, and other metals, necessary to produce the very many designs of special tanks, pipes and retorts capable of withstanding these excessive pressures while under the influence of very high or extremely low temperatures. Without the marvelous advances in modern steel technology, it would practically have been impossible to even dream of producing 750,000 tons of man-made rubber per

year, a dream which is rapidly nearing fruition. As a matter of fact, without the steel industry, our great chemical industries would still be only in the pilot plant or test tube stage.

And now, what about war-time insulated cables?

The principles of cable engineering and design as set forth in our 1937 paper can still be used as the rule and guide for safe practices in the steel industry and for that reason, these features will not be covered by the present paper. Our chief concern is to bring you up-to-date on the types of cable available to you as of September 1, 1943.

AVAILABLE INSULATING AND PROTECTIVE MATERIALS

On August 17, 1943 the War Production Board issued a directive which in effect, prohibits the use of crude rubber as insulation or the protective jacket of any commercial type of cable, regardless whether for civilian or government use. It won't be very long now, probably by January 1944, when crude rubber will no longer be available to the cable industry for any type of cable even including the types needed by the armed forces. The nation's stock pile of crude rubber is very low and the little that has been allotted is of such poor quality, as to make it unnecessary to shed any tears over the WPB's edict.

Our industry had some warning as to what was coming and through the very excellent cooperation between the Underwriters' Laboratories, A. S. T. M. and special industry committees of N. E. M. A., sufficient emergency specifications have been drawn up so as to enable the immediate production of the permissive types of wires and cables for any voltage and installation condition. As a matter of fact, the industry is already producing wires and cables with Buna S and very soon the marvel of yesterday will become the commonplace of tomorrow.

The insulations and protective coverings available today may be seen from the following tabulation:

Insulations	*Protective coverings*
Synthetic (Buna S) rubber	Synthetic (Buna S) rubber sheaths
Synthetic resins	Synthetic (Neoprene) rubber sheaths
Reclaimed rubber	Synthetic resin sheaths
Varnished cambric cloth (V.C.)	Braids* of cotton, jute, seine twine steel
Oil-impregnated paper	Servings of treated jute or other fibrous layers
Asbestos and V.C.	Servings of flat steel tape on round wire armor
	Various compound-filled tapes**

*Braids of sisal yarn are unavailable at present.

**Cable tapes, known as rubber-filled tapes, may no longer be made with crude or even reclaimed rubber, but are permitted to be filled with a compound containing synthetic rubber or other suitable insulating composition.

Our further discussions will concern themselves chiefly with the various types of available synthetic rubber and synthetic resins being used by the cable industry, since these are new, whereas the merits and uses of varnished cambric, oil-impregnated paper and asbestos have already been sufficiently discussed in our 1937 paper.

Since most of the synthetic rubbers are being produced in government owned plants or under government sponsorship, the WPB has adopted a number of alphabetical designations in order to avoid the necessity of repeating such terms as rubber hydrocarbon or isopolybutylene. These designations and their significance are given in Table I.

TABLE I

List of WPB Compound Designations and Their Significance

GR-S	= Buna S type of synthetic rubber.
GR-M	= Neoprene type of synthetic rubber.
GR-I	= Butyl type of synthetic rubber.
RHC	= Rubber hydrocarbon and generally denotes the per cent rubber by volume, where permitted in a compound. This term is used regardless as to whether the rubber originates in the form of crude, reclaim or latex.
SRV	= Synthetic rubber by volume and generally denotes the per cent of synthetic rubber by volume in a compound regardless of the type of synthetic rubber used.
W-CS-14	= Code grade insulation, corresponding to that known as type R and may consist of a combination of a limited quantity of Buna S and reclaimed rubber.
W-AS-6	= A group of higher grade compounds richer in the permissive quantity of Buna S rubber that may be used. Within these limitations, the W-AS-6 compound will provide insulations of A. S. T. M. emergency heat-resistant grade, Underwriters' emergency type RH grade, A. S. T. M. emergency performance grade, A. S. T. M. emergency ozone-resistant grade and other grades developed for special purposes.
W-SM-6	= A Neoprene jacket compound designed for use on portable cables intended for use where severe abrasion resistance is required. Such cables or cords are generally designated as the heavy duty type.
W-SM-8	= A Neoprene jacket compound designed for use on such portable cables, where resistance to abrasion is not a prime necessity. Such cables and cords are generally designated for light duty services.
W-SS-4	= A Buna S jacket compound designed for uses similar to those described for the W-SM-6 compound.
W-SS-6	= A Buna S jacket compound designed for uses similar to those described for the W-SM-8 compound.
W-SI-4	= Butyl rubber compounds for insulating or jacketing purposes. Such compounds are at present, still in the process of development.
Impervious sheath	= Any type of protective jacket which will not support combustion and which will withstand 25 psi air or water pressure, applied externally or internally.

SUITABILITY OF VARIOUS SYNTHETIC RUBBER TYPES

The term synthetic rubber is probably a misnomer for the above named materials, nor can they be properly termed as rubber substitutes. The term has caught the public fancy and will probably continue for many years but the facts are that these materials have nothing to do with rubber. They are chemically different, they do not possess the basic ingredients found in crude rubber and their only resemblence to natural rubber is in physical appearance, feel and general performance.

Buna S, Butyl and Neoprene are entirely new materials and should be considered as such by the entire industry. Each of these has its own particular properties which distinguish it from natural rubber or the other types of rubber-like materials. As we continue to work with these comparatively new materials, their respective properties will undoubtedly be brought more forcibly to the fore so that at some future date, even if natural rubber should once more be available to our

industry, we will definitely prefer to use these rubber-like materials for certain types of cable.

Buna S, for example, is the universal type of rubber-like material which can be processed with present type of rubber mill equipment, can be mixed with rubber or reclaimed rubber in all proportions, can be utilized both as insulation as well as jacket, possesses good tensile strength, dielectric strength and other electrical properties. As a matter of interest, even with lower values of insulation resistance, Buna S compounds have been produced which have a dielectric constant, vastly superior to that obtainable with natural rubber compounds of similar formulations. It is now plentifully available to the cable industry and will be made more so, next year. Its cost is reasonable with every indication of further improvements in that direction in the future.

Butyl rubber is a very remarkable type of rubber-like material, having very excellent properties and in certain formulations, very excellent physical properties as well. Its processing however is much more difficult than with Buna S and this is one of the reasons why it has not been used as widely as Buna S. Another reason is the fact that it is not as yet being produced in very large quantities and accordingly, the entire output has been diverted until January 1, 1944 to the production of gas masks and inner tubes used on combat equipment. Butyl rubber compounds are from four to six times as resistant to the passage of air and gases, as the best rubber compound available. In addition, certain formulations possess excellent ozone resistance.

Neoprene is not new to the industry although its very extensive use was definitely brought about as a result of the present war. It represents the very best example of what we tried to bring out in the preceding paragraphs regarding the misuse of the term synthetic rubber when applied to these materials. There is no natural rubber compound which can even approximate the distinctiveness of Neoprene which is at once resistant to the active rays of the sun, flameproof, possesses good physical properties, resistant to the solvent action of oils and most acids and alkali, reasonable in cost and can be processed per the procedures and with the same equipment as used for rubber compounds. True, its electrical properties are not all that may be desired but Neoprene insulated conductors have been used successfully for services below 600 volts.

However, as a jacketing material, designed to protect an insulated conductor from many of the surrounding deteriorating influences, that is where Neoprene performs without a peer. In addition to all of its other marvelous properties, Neoprene possesses very excellent resistance to elevated temperatures as well as ozone, and the day has been saved for many a hazardous installation, by the judicious protection of the insulated conductor with a properly formulated Neoprene jacket.

SUITABILITY OF SYNTHETIC RESINS

There are two synthetic resins, frequently referred to as "rubber-like" or even as "synthetic rubber," which have found very wide acceptance and extensive use as cable insulation and jacketing materials. These are known by the trade name of Koroseal and Vinylite. Technically, Koroseal is known as polyvinyl chloride while Vinylite is a chemical blend of polyvinyl chloride and vinyl acetate.

Both Koroseal and Vinylite do not represent a single compound but rather a family or group of compounds, each of which is specially designed and compounded to produce a given end result. A synthetic resin consists essentially of the basic resin in powdery form, combined with softening materials known as plasticisers, in various percentages. One formulation is designed for operation at extremely high temperatures such as 100 C and may be brittle at temperatures below 0 C, while others may be suitable for operation at temperatures as low as −40 C but may prove unsuitable at temperatures above 60 C.

We will treat both Koroseal and Vinylite as one material for the further purposes of this paper. The vinyl resins (that is how we will refer to them) can be and generally are processed on rubber mill equipment, although within the past few years, special types of extrusion equipment have been developed which have been instrumental in yielding greater production speeds. These vinyl resins are being fabricated daily in very large quantities, both as insulations and jackets of a very wide variety of cables intended for communication, signalling, lighting and power purposes. Literally millions of feet of such wires and cables have been produced within the past few years for use with all types of combat equipment operating on land, sea, air and underwater.

The vinyl resins also represent a miracle in chemical achievements because, although derived from several basic sources, one of which is acetylene gas, nevertheless, the finished product is flameproof, oil proof, sun proof, resists the solvent action of most acids and alkali, possesses high dielectric strength and other useful electrical properties. They can be furnished in practically all of the colors of the rainbow thereby eliminating the need of braids for polarity and other types of identification.

When used as an overall jacketing material, they provide a sheath which is not only highly resistant to chemical action, but which is impervious to the passage of air and water even though impelled by internal or external pressures. In addition, such sheaths are free from galvanic as well as chemical corrosion and in the case of single conductor cables carrying alternating currents, they are free from the induced sheath currents generally encountered with metallic sheaths.

Electrically, the vinyl resins are being universally recognized for general services up to 600 volts and for series lighting at voltages up to 3000 volts. Such cables can be installed in underground ducts, in conduits, in trenches, aerially or underwater. The author has recently inspected some submarine mine depot cable in which both the conductor as well as the protective jacket, consisted of vinyl resins. This cable had been doing service for a period of three years and was still doing a good electrical job at the time it was withdrawn from the water for the purpose of observing its physical condition. The jacket was torn in places where the cable had chafed over some underwater rocks, but no worse than other cables of the rubber jacketed types.

The vinyl resins have been recognized by the National Electrical Code as type SN wire for use as general

TABLE II — WPB Compound Limitations

Use	Compound grade	Maximum per cent by volume		Performance references specifications
		SRV	Total of SRV and RHC	
Insulation	W-CS-14 (GR-S)	25	50	N. E. C. grade — type R
	W-AS-6 (GR-S)	65	65	A. S. T. M. ES-33 or ES-34 N. E. C. grade — type RH
Jackets or impervious sheath	W-SS-4 (GR-S)	75	75	A. S. T. M. ES-6
	W-SS-6 (GR-S)	65	65	In course of preparation
	W-SM-6 (GR-M)	65	65	A. S. T. M. ES-28
	W-SM-8 (GR-M)	55	55	A. S. T. M. ES-30
	W-SI-4 (GR-I)	75	75	To be prepared

TABLE III — List of Available Types of Commercial Wires and Cables

Type of product	Range in operating voltage	Grade of compound for	
		Insulation	Jacket
Armored cable (ABC)*	0–600	W-CS-14	None
*Because of restrictions on steel, armored cable may not be manufactured without appropriate WPB permission.			
Borehole or suspension cable, fibrous covered	0–5000	W-AS-6	None
Building wire and power cable			
Dry locations			
Fibrous or lead	0–3000	W-CS-14	None
Lead covered	3001–5000	W-CS-14	None
Fibrous covered	3001–5000	W-AS-6	None
Fibrous or lead	5001 and over	W-AS-6	None
Wet locations			
Lead or impervious sheath	0–3000	W-CS-14	W-SM-6
Lead or impervious sheath	3001–5000	W-AS-6	W-SM-6
Fibrous covered	All	W-AS-6	None
Special service applications			
Copper temperature above 60 C	0–5000	W-AS-6	None
Motor leads	0–5000	W-AS-6	None
Severe mechanical conditions	0–5000	W-AS-6	None
Fixture wires (RF and FF)	0–300	W-CS-14	None
Fire alarm and signaling cable	0–600	W-CS-14	None
Flexible cords — Underwriters' types,			
Fibrous covered	0–600	W-CS-14	None
All rubber types SJ and SV	0–600	W-AS-6	W-SM-8
All rubber type S	0–600	W-AS-6	W-SM-6
Loom covered (type PWP)	0–600	W-CS-14	Special reclaim
Non-metallic sheath cable, Underwriters' type	0–600	W-CS-14	None
Non-metallic sheath cable for direct burial	0–5000	W-AS-6	None
Oil burner ignition cable	0–15000	W-AS-6	None
Parkway cable — lead covered	0–3000	W-CS-14	None
	3001–5000	W-AS-6	None
Portable appliance service cord (loom covered)	0–600	W-CS-14	Special reclaim
Portable cable (heavy duty)	0–5000	W-AS-6	W-SM-6
All rubber types — Sizes No. 8 Awg. and larger or with more than 4 conductors, for use on portable drills, tools and other industrial appliances, construction machinery, air compressors, cement mixers, conveyors, hoists and electrically operated locomotives.			
Loom covered types — for same uses as given for all rubber types	0–5000	W-AS-6	W-SM-8
Portable cable (light duty)	0–5000	W-AS-6	W-SM-8
All rubber types — Sizes No. 10 Awg. and smaller or with not more than 4 conductors, for use on portable drills, tools and other industrial appliances as well as construction machinery. Welding machinery power leads of any conductor size.			
Loom covered types — for same use as given for all rubber types	0–5000	W-AS-6	W-SM-8
Powerduct**	0–6000	W-CS-14	None
**Anaconda trade name for plug-in loom covered power cable.			
Telephone wire	All	W-CS-14	None
Welding cable, electrode holder	All	W-AS-6	Loom covered
Combined insulation and jacket	All	.....	W-SM-6

TABLE IV — Additional Types of Available Commercial Cables

Type of product	Voltage range	Type of insulation
Building wire		
Underwriters' type SN	0–600	Vinyl resins
Underwriters' type V	0–5000	Varnished cambric
Underwriters' type A	0–600	Asbestos (unimpregnated)
Underwriters' type AI	0–600	Asbestos (impregnated)
Underwriters' type AVC	0–5000	Asbestos-V. C.
Underwriters' type WP	0–600	Triple braid weatherproof* (on knob and tube)
Underwriters' type SB	0–600	Slow burning* (on knob and tube. In conduit for temperatures between 60 and 90 C)
Apparatus cable	0–5000	Varnished cambric
Machine tool wiring	0–600	Vinyl resins
Power cable — synthetic resin	0–600	Vinyl resins (Conductor sizes 500,000 cir mils and smaller)
AVC type	0–7500	Asbestos-V. C.
Varnished cambric	0–28000	Varnished cambric
Paper cable — solid type	0–69000	Oil-impregnated paper

*These are not insulations but coverings, considered suitable up to 600 volts under code controlled installation conditions.

interior wiring wherever rubber has been previously permitted and as type SNA, for switchboard wiring where temperatures up to 90 C may be encountered. Due to their excellent oil resistance, conductors insulated with these resins have been adopted as standard wiring materials for all machine tools.

PRESENT WPB LIMITATIONS

For the time being, the War Production Board has not only prohibited the use of crude rubber and rubber latex on any commercial types of wires and cables, but has also imposed limitations on the percentage of synthetic rubber (and reclaimed rubber in the case of the type R compound W-CS-H), which may be used in the various compounds. No such limitations have been imposed on the vinyl resins, either as to composition or where they may be used.

Table II gives a list of the various WPB compounds of Buna S, Neoprene and Butyl rubber, together with performance references in the forms of industry specifications. The latter are being given as a guide only and are not to be construed as mandatory.

TYPES OF COMMERCIAL WIRES AND CABLES AVAILABLE

With the foregoing before us, we are now in a position to give a list of the commercial types of wires and cables that are available and the types of insulation and jacket compounds used in their manufacture. In preparing this list we have tried to present the various cable types in alphabetical order for more ready reference.

In Table III, we concerned ourselves only with those products employing the so-called synthetic rubber, either as insulation or jacket. There are however other types available, which must be given consideration before selecting a given type of wire or cable. We refer of course to those insulated with the vinyl resins, varnished cambric, oil-impregnated paper, asbestos or asbestos-V. C. combinations. Then there are the triple braid weatherproof (Underwriters' type WP) and slow burning (Underwriters' type SB) cables, whose coverings, although not strictly to be classified as insulations, nevertheless have a limited application up to 600 volts in many industrial installations.

During the present emergency, when most cable making facilities are devoted to the needs of the armed forces both here and abroad, it may not always be possible to secure immediate delivery of a given type of insulated cable whereas an alternate type may be procurable much faster. In addition, such other considerations as smaller overall diameter, higher operating temperatures either as a result of high ambients or increased current ratings, or considerations of cost, etc., may dictate the desirability of using other types of cable. Table IV gives a list of additional types of available commercial cables.

OPERATING LIMITATIONS OF AVAILABLE MATERIALS

In order to secure a more comprehensive picture of the permitted applications of the various materials already discussed, as well as their operating limitations, we have prepared Table V which gives this information in compact form. A careful study of this tabulation, will soon enable the reader to know exactly what choice of materials there are available in order to meet a given set of operating conditions.

In making this study, it should be noted that impregnated paper cable has been listed as suitable for quite a number of operating conditions that might be open to question. Our reason for making these listings is based on the fact that paper cable is always furnished with an impervious sheath, generally a lead sheath, and the ends are suitably protected by means of an impervious joint or terminating device.

RECENT ADDITIONAL RULINGS

In addition to the foregoing, two rulings of import-

ance have recently been released to the industry, which are worthy of note. They are,

(1) The Underwriters' Laboratories have not as yet accepted a Buna S type of RW compound (suitable for operation in moist locations without a lead sheath). Since the use of crude or material rubber has been prohibited for commercial types of wires and cables on and after September 1, 1943, the Underwriters have ceased labeling any type RW wires and cables made after August 31, 1943.

They are however, in conjunction with the cable manufacturers, conducting an investigation into the stability of RW compounds made with Buna S and it is anticipated that by the latter part of October 1943, they will be in a position to render a decision as to whether the Buna S type RW conductors are as suitable for this purpose as the original approved materials.

In the meantime, the only solution to this problem, where the code has jurisdiction, is to use W-CS-14 insulation under a lead sheath. For all other cases consult the data in Table V.

(2) In an effort to conserve natural rubber during the present emergency, the WPB prohibited the use of natural, synthetic or reclaimed rubber for the insulation of the "white" or neutral conductor of a 600 volt grounded neutral system. The National Electrical Code recognized this in the form of an interim amendment which permitted the use of a white WP, SBW, EG or EI wire, as the grounded neutral conductor.

Due to the availability of Buna S rubber for the wire and cable industry in substantial quantities, the WPB lifted this restriction and it is now permissible to furnish the "white" wire with the same type of insulation as used on the "hot" wires. However, as far as the code is concerned, the provisions of the interim amendment previously mentioned still apply and either practice is permissible for 600 volt grounded-neutral systems. However for ungrounded systems, for direct current or where feeders are used as switch legs, the white conductor must be of the insulated type.

CONCLUSION

We have attempted to present a picture of the commercial types of wires and cables of interest to the steel industry that will be available after September 1, 1943. In our description of the various types of rubber-like materials, we could have mentioned a number of additional types which will undoubtedly have an important impact on the wire and cable industry in the postwar period. We refrained from doing so because for quite some time these materials will only be available for use by the armed forces and could therefore not be utilized in the production of cables for the steel industry. Postwar wires and cables made with some of these materials will doubtless play a very important role in the field of communication, television and power transmission at both high and low voltages. Possibly at some future date, an opportunity may be presented to cover this phase of the subject adequately.

Although much work still remains to be done in developing the various types of rubber-like materials to the highest degree of perfection, we wish to assure the user of commercial types of war-time insulated wires and cables, that the products described in the preceding pages will give adequate and satisfactory performance, if the limitations listed in Table V are carefully observed.

TABLE V — Operating Limitations

Type of insulation jacket or covering	Maximum conductor temperature C	Maximum operating voltage (rms)	Suitable for:			Resistant to the following:				
			Interior wiring	Outdoor wiring	Moist locations	Oils	Industrial fumes and vapors	Acids and alkali	Sunlight	Ozone
W-CS-14, type R	50	2000	Yes	Yes†	Yes†	No	No†	No†	No†	No
W-AS-6, type RH	75	2000	Yes	Yes†	Yes†	No	No†	No†	No†	No
W-AS-6, performance	60	2000	Yes	Yes†	Yes†	No	No†	No†	No†	No
W-AS-6, ozone resistant	75	10000	Yes	Yes†	Yes	No	No†	No†	No†	Yes
W-AS-6, Duracode	75	2000	Yes	Yes†	Yes†	No	No†	No†	No†	No
W-AS-6, type RW*	50	600	Yes*	No*	Yes*	No	No†	No†	No†	No
Vinyl resin insulation	60	600	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Varnished cambric	85**	28000	Yes	No†	Yes†	Yes	No†	No†	No†	Yes
Impregnated paper (solid type) (lead covered)	85**	69000	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Asbestos — type A	200	600	Yes	No	No	No	Yes	No†	No†	Yes
type AI	125	600	Yes	No	Yes	No	Yes	No†	No†	Yes
type AVC	110**	7500	Yes	Yes†	Yes†	No	No†	No†	No†	Yes
Underwriters' type SB	90	600	Yes	No	No	No	Yes	No	No	No
type WP	90	600/	Yes	Yes	No	No	No	No	Yes	No
Jackets — vinyl resins	60	.....	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
W-SM-6 and 8	75	.....	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
W-SS-4 and 6	60	.....	Yes	No‡	Yes	No	?	?	No	No

*Not yet available but standards in course of preparation by Underwriters' Laboratories.
**Depends on the voltage, decreasing with increase in voltage rating.
/On knob and tube only, for interior wiring or on insulators for outdoor wiring.
†Only if protected by a lead or other impervious sheath.
‡Not suitable for exposure to sunlight unless protected by weatherproofed fibrous covering.

Scale Prevention BY DIRECT Chemical Treatment OF WATER IN Boilers

. . . . direct chemical treatment, or "internal" treatment, of water in boilers is widely used, usually following a pretreatment, but in many cases, forming the entire water conditioning process . . . .

by W. H. Thompson

DIRECTOR OF SERVICE

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▲ VERY few natural waters are suitable for boiler feed use without some form of direct chemical treatment in the boiler or some form of pretreatment. Even in those cases where pretreatment of make-up water is practiced the direct treatment of the water in the boiler is needed in order to insure against variations in the quality of water from the pretreatment plant, process chemical contamination of the return condensate or leakage of hard water, such as used for condenser cooling, into the return condensate supply.

The use of chemical treatment directly in the boiler is entirely logical as it is the condition of the boiler water that determines:

1. Whether heat transfer surfaces will remain clean and free from scale deposits.
2. Whether carryover of boiler water solids into steam lines will be prevented.
3. Whether the boiler will be free from other less common troubles such as intercrystalline cracking, corrosion from oxygen or hydrogen, etc.

The term hardness applied to feedwater or boiler water means the total amount of calcium or magnesium present. The high temperature of the boiler water speeds up chemical reactions and in the absence of correct treatment the hardness concentrates rapidly in the boiler water and forms scale on the boiler metal. This scale occurs mainly in one of two ways or a combination of both. It may be formed by direct crystallization of solids from a supersaturated solution at the heat transfer surface in the boiler or it may be formed by the baking on to the boiler metal of sludge previously precipitated from the boiler water by heat and chemical reaction, or it may be formed by a combination of both of these methods.

When raw water is used for boiler feed the need for direct treatment for scale prevention is obvious. Calcium sulphate must be promptly converted to insoluble non-scaling sludge form as calcium carbonate or phosphate in the boiler water so that scale formation caused from supersaturation is prevented. The insoluble precipitates of calcium carbonate, calcium phosphate and magnesium hydroxide must be conditioned or coagulated by the direct treatment so they are non-adherent in physical form and circulate freely with the natural movement of the boiler water.

The basic chemical reactions involved in direct treatment of boiler water are very simple. Calcium carbonate is precipitated from the bicarbonate and magnesium hydroxide from magnesium bicarbonate by the high temperature of the boiler water, thus they require only sludge conditioning treatment to render them non-scaling in nature. This precipitation is accelerated by the alkalinity normally present in the boiler water although no consumption of the total soda alkalinity occurs in the process.

Calcium and magnesium sulphates and chlorides require either sodium carbonate (soda ash), caustic soda or sodium orthophosphate for the precipitation of the calcium and magnesium insoluble sludge and this sludge in turn requires conditioning chemicals to render it non adherent in nature.

The materials used in direct treatment of boiler water are of two general classes. Inorganic chemicals such as soda ash, caustic soda, and sodium orthophos-

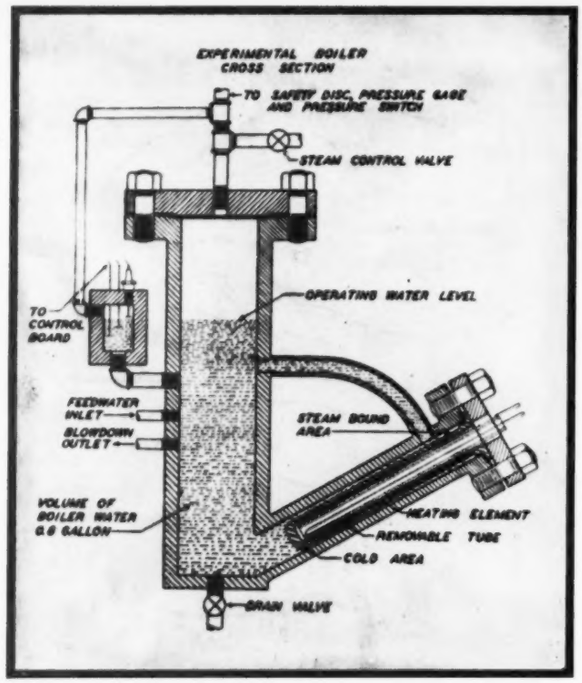


Figure 1 — Cross section of experimental boiler.

phate are used to react with encrusting calcium and magnesium salts and to provide correct alkalinity in the boiler water. Sodium aluminate is used as an inorganic coagulant and sludge conditioning reagent. Organic chemicals such as extracts from various plants containing alginates, glucosides, tannins, lignins and lignin derivatives are used for conditioning the precipitated sludge and for coating or dyeing each sludge crystal or particle as it is formed so that the crystals are deformed and weak and non adherent in nature.

The use of blends or combinations of organic and inorganic chemicals has largely supplanted the use of either class alone. When inorganic chemicals are used alone they accomplish the primary need of water softening and alkalinity balances in the boiler water but do not condition the sludge or precipitate formed so that it is non-adherent. When organic materials are used alone the primary need for soft water in the boiler is not usually accomplished. With properly blended combinations of organic and inorganic treatment both soft water and sludge conditioning are obtained so that optimum conditions of scale elimination are held at all times.

Tests have been made in the company's research laboratory experimental boilers on hundreds of combinations of organic materials blended with various softening chemicals at boiler pressures from 100 psi to 1000 psi. Figure 1 shows cross section view of the experimental boilers used in these tests. Feedwater of any desired chemical composition can be used for the experimental boilers and the results of direct chemical treatment on scale formation on the removable tube studied. The thickness of scale on the tube is measured, then it is analyzed chemically and by means of petrographic microscope or by the X-ray diffraction method if needed.

It has been found that certain blends of organic and inorganic chemicals are most effective on feed waters of one composition (for example high in calcium and low in magnesium) while entirely different types of organic chemicals and blends with inorganic chemicals are necessary on feed waters of changed composition. Increases in boiler pressure and rating introduce additional variables, which must be taken into consideration in recommendation of proper treatment for scale elimination.

Figure 2 shows photomicrographs of various types of crystal structure produced by blends of different types of organic materials with softening chemicals at 250 psi.

Figure 2 — Photomicrographs (15 x) showing effect of various organic materials on boiler scale crystal structure at 250 psi 25 grains per gal total alkalinity. Left to right: no organic material, gallic acid, tannin, sugar derivative, and lignin derivative.

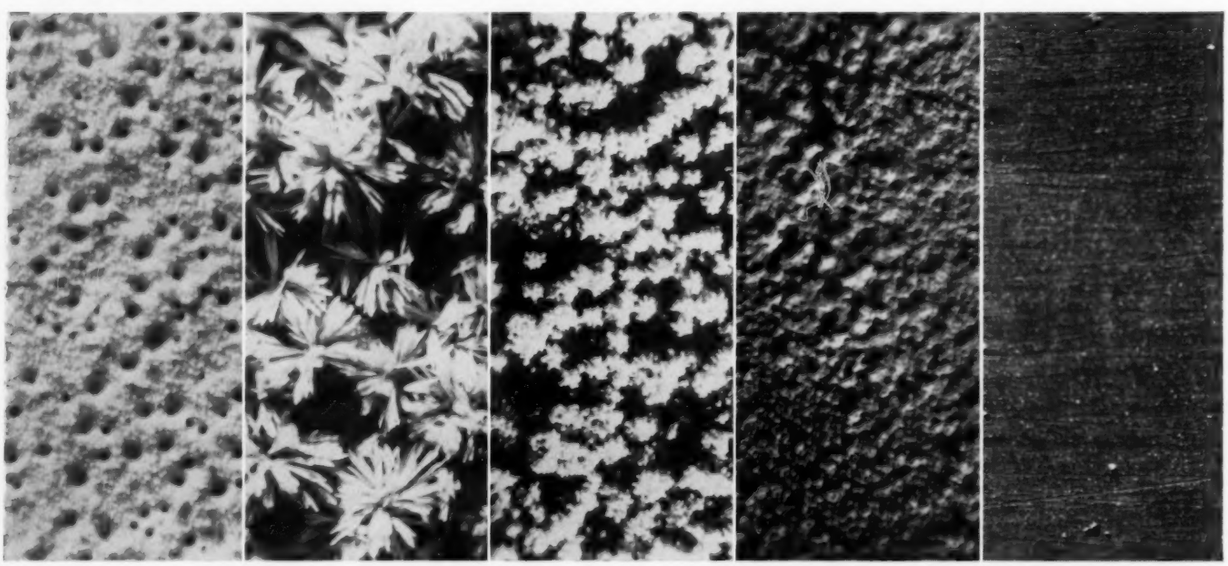


TABLE I

A — REACTIONS BY HEAT

(1)	$Ca(HCO_3)_2$ Calcium bicarbonate (soluble)	+	heat	→	$CaCO_3$ Calcium carbonate (precipitate)	+	H_2O Water	+	CO_2 Carbon dioxide	
(2)	$Mg(HCO_3)_2$ Magnesium bicarbonate (soluble)	+	heat	→	$MgCO_3$ Magnesium carbonate (slightly soluble)	+	H_2O Water	+	CO_2 Carbon dioxide	
(2a)	$MgCO_3$ Magnesium carbonate (slightly soluble)	+ H_2O +	heat	→	$Mg(OH)_2$ Magnesium hydroxide (precipitate)			+	CO_2 Carbon dioxide	

B — REACTIONS BY SODA ASH, CAUSTIC SODA AND SODIUM PHOSPHATE

(1)	$CaSO_4$ Calcium sulphate	+	Na_2CO_3 Sodium carbonate (soda ash)	→	$CaCO_3$ Calcium carbonate (precipitate)	+	Na_2SO_4 Sodium sulphate			
(2)	$CaCl_2$ Calcium chloride	+	Na_2CO_3 Sodium carbonate (soda ash)	→	$CaCO_3$ Calcium carbonate (precipitate)	+	2NaCl Sodium chloride			
(3)	$MgSO_4$ Magnesium sulphate	+	2NaOH Caustic soda	→	$Mg(OH)_2$ Magnesium hydroxide (precipitate)	+	Na_2SO_4 Sodium sulphate			
(4)	$MgCl_2$ Magnesium chloride	+	2NaOH Caustic soda	→	$Mg(OH)_2$ Magnesium hydroxide (precipitate)	+	2NaCl Sodium chloride			
(5)	$10CaSO_4$ Calcium sulphate	+	$6Na_3PO_4$ Trisodium orthophosphate	+	2NaOH Caustic soda	→	$Ca_{10}(PO_4)_6(OH)_2$ Calcium phosphate (hydroxyapatite)	+	$10Na_2SO_4$ Sodium sulphate	
(6)	$10CaCl_2$ Calcium chloride	+	$6Na_3PO_4$ Trisodium orthophosphate	+	2NaOH Caustic soda	→	$Ca_{10}(PO_4)_6(OH)_2$ Calcium phosphate (hydroxyapatite)	+	20NaCl Sodium chloride	

Theoretically the best boiler water is a water which is completely pure, that is, free from dissolved and suspended solids and free from dissolved gases, such as carbon dioxide, oxygen and ammonia. Actually, boiler water of such purity is non existent in those plants operating at moderate boiler pressures and with considerable process steam requirements. Central station power generation plants usually come the closest to this ideal as the quantity of make-up water in these plants is very small and this small quantity of make-up water needed is frequently obtained from evaporators.

The most desirable and practically obtainable boiler water is one of properly balanced dissolved solids content and the minimum amount of suspended solids or sludge. The permissible quantity of sludge in the boiler water decreases with increase in boiler rating and with boiler pressure, although the actual quantity of sludge present in the boiler water is of considerably less importance than the condition of the sludge from the standpoint of its fluidity or stickiness. When boiler water sludge is well coagulated or properly conditioned it flows freely with the natural circulation of the boiler water and does not form an adherent deposit, but when it is poorly conditioned it may form an adherent deposit especially in the cooler portion of the boiler and in locations where natural circulation of the boiler water is slower and follows less clearly defined paths.

When magnesium hydroxide is present in moderate amounts in boiler water which has been treated with blended chemicals such as soda ash, sodium aluminate and lignin derivatives it is of great aid in conditioning the whole body of calcium and magnesium sludge so that it is non adherent in nature. It adsorbs silica and has been used to prevent silicate scale in boilers.

Experimental boiler test runs in the research laboratory were made at 200 psi, with total alkalinity of 25.0 grains per gallon (terms of $CaCO_3$) in the boiler water, varying the quantities of calcium and magnesium in the feed water to find the amounts of scale under each condition. No organic or phosphate treatment was used. Table II shows tabulation of these test runs. The amount of scale formed under these conditions from a feed water containing calcium hardness only is relatively great unless the calcium hardness of the feed water is very low. In these tests the presence of magnesium with the calcium in the feed water was of benefit in reducing the quantity of scale formation occurring. Similar results have been reported in actual plant operation. The presence of the large amounts of magnesium hydroxide is undesirable however when soluble phosphate is maintained in the boiler water. It adsorbs phosphate and the resulting magnesium-phosphate sludge is very sticky and adherent in nature. It is desirable therefore to adjust the chemical dosage for magnesium elimination in a pretreatment or softening plant which is preparing feed water for use in boilers where direct phosphate after-treatment is applied so that sticky magnesium phosphate sludge in the boiler will be prevented.

A typical example of boiler water using direct chemical treatment at a boiler pressure of 150 psi and where the boiler rating is not excessive, would contain approximately 140 grains per gallon or less of dissolved solids and 125 grains per gallon or less of suspended solids or sludge. The total alkalinity of the boiler water would be from 15 per cent to 20 per cent of the dissolved solids. Sodium sulphate, sodium chloride and organic material constitute the bulk of the remaining dissolved solids, with small amounts of sodium silicate, sodium nitrate, etc. usually present. Such a boiler water is usually easily obtained by direct chemical treatment and blowdown control of the average quality of raw water used for boiler feed make-up.

In those cases where the boiler water contains large amounts of sludge and relatively low dissolved solids content the total alkalinity of the boiler water may

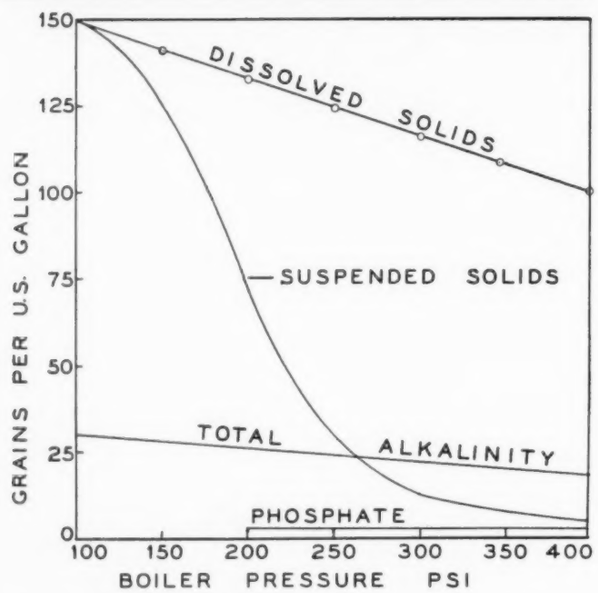


Figure 3 — Relationship between dissolved solids, suspended solids and alkalinity in average boiler water handled by direct treatment.

considerably exceed 20 per cent of the dissolved solids content. The A. S. M. E. suggested rules for care of power boilers, 1940 edition, advise a minimum boiler water alkalinity concentration of 15 grains per gallon in terms of sodium carbonate for corrosion prevention.

Figure 3 shows the relationship between dissolved solids, suspended solids and alkalinity in a hypothetical average boiler water being treated by direct chemical feed at various boiler pressures and moderate boiler ratings. Many instances have been noted where it was possible to maintain higher concentrations of suspended or dissolved solids than shown, but average conditions are as noted.

The amount of soluble salts in any feed water which will concentrate in the boiler water can be easily calculated. As inorganic chemicals are added to completely precipitate all of the calcium and magnesium and to provide correct boiler water alkalinity, any sulphates or chlorides of calcium or magnesium will be changed to the corresponding amount of sodium sulphate or chloride. Thus the soluble salts in the feed water which will concentrate in the boiler water are equal to the total dissolved solids in the feed water plus the added or natural soda alkalinity excess over the hardness minus the total alkalinity, or in equation form:
This equation can be used for either grains per gallon or parts per million as long as the same terminology is used throughout.

Referring to Figure 3 either the dissolved solids content or the suspended solids content of the boiler water may be the limiting factor in determining the maximum concentration ratio which can be carried with any particular feed water. If the dissolved solids of the feed water which will concentrate in the boiler water are low and the hardness or potential sludge content of the feed water is high, then the sludge content of the boiler

Soluble salts in feed water which will concentrate in the boiler water (Terms of $CaCO_3$)	=	Total dissolved solids of feed water by gravimetric or other measure in terms of $CaCO_3$	+	
Added or natural soda alkalinity excess above hardness of feed water (Terms of $CaCO_3$)		— Total alkalinity of feed water (Terms of $CaCO_3$)		

water becomes the limiting factor for concentration control. For example: at 150 psi with a feed water of total dissolved solids of 20.0 grains per gallon and total hardness of 18.0 grains per gallon and a total alkalinity of 18.0 grains per gallon in which the added soda alkalinity excess above the hardness would be 3.5 grains per gallon, it would be necessary to carry not more than 7.0 concentration ratio to keep the boiler water sludge content below approximately 125.0 grains per gallon. Also referring to the outlined method for predicting the feed water dissolved solids content which will concentrate in the boiler and using the above feed water we would have dissolved solids in the boiler water of 38.5 grains per gallon at 7.0 concentration ratio. However if the dissolved solids content of the feed water is high and the hardness or potential sludge content of the feed water low, the dissolved solids are the limiting factor for concentration control. For example, at 150

TABLE II

EXPERIMENTAL BOILER TEST RUNS AT 200 PSI, TOTAL ALKALINITY 25.0 GRAINS PER GALLON (TERMS $CaCO_3$) WITH VARYING QUANTITIES OF CALCIUM AND MAGNESIUM IN THE FEED WATER

Boiler test run number	Feedwater composition grains per gallon as $CaCO_3$			Thickness of scale formed millicentimeters
	Calcium	Magnesium	Total alkalinity	
1774	8.0	0.0	10.5	22
1775	6.0	0.0	8.5	20
1777	2.0	0.0	4.5	6
1765	8.0	2.0	12.5	7
1766	6.0	4.0	12.5	6
1776	2.0	8.0	12.5	6

psi with a feed water dissolved solids of 20.0 grains per gallon, a total hardness of 5.0 grains per gallon and a total alkalinity of 5.0 grains per gallon in which the added soda alkalinity excess above the hardness would be 3.5 grains per gallon, it would be necessray to carry not more than 7.5 concentration ratio to keep the boiler water dissolved solids content below 140 grains per gallon. This concentration ratio would give a boiler water sludge content of approximately 37.5 grains per gallon.

It is possible to maintain higher boiler water dissolved solids and concentration ratio without wet steam or carryover when the sludge content of the boiler water is low. Thus for extremely hard waters external pretreatment is recommended in addition to direct treatment in the boiler because of the higher blowdown losses which might otherwise be necessary.

Control of boiler blow down is usually based on dissolved solids tests of the boiler water. Where means for making the total dissolved solids test are not available, blowdown is controlled by test of concentration ratio, or ratio between the amount of a soluble salt such as sodium chloride (NaCl) in the feed water and in the boiler water. Both dissolved and suspended solids in the boiler water are present in higher concentrations near the surface of the water when the boiler is steaming rapidly. When the boiler is banked the suspended solids settle to the lower parts of the boiler. Therefore it is desirable to use the continuous blowdown which takes water from near the surface when the boiler is operating, and to use hand blowdown when the boiler is banked and just before it is put back on the line.

Carryover of boiler water into the steam lines may be caused from chemical reasons, mechanical reasons or conditions of plant operation. Excessive concentration of dissolved and/or suspended solids in the boiler water is one of the most common chemical reasons for its occurrence. Others are improper sludge conditioning, and contamination of the boiler water with oil, soap or sewage. Mechanical reasons include type or design of the boiler, steam release area and height of water carried in the gage glass. Wide variations in steam load or conditions of sudden steam demand sometimes are responsible for wet steam.

New types of chemical film breakers or antifoams have been developed in the research laboratory of the writer's company which are very effective for prevention of carryover. These new antifoams are used in low dosages, usually a few parts per million, have a much more lasting result than old type materials and do not contain saponifiable oil which might form soaps or other objectionable reaction products in the boiler water.

The application of direct chemical treatment to the boiler water is usually made by a chemical line going either into the boiler drum or into the feed water line going to the boiler. Chemical treatment is added either continuously or intermittantly by means of chemical pumps or pot type by-pass feeders.

For slug feed of chemical solutions the use of a chemical pump and time switch to apply treatment automatically at regular intervals and in a predetermined volume has been used very effectively.

Continuous feed of chemical treatment is most desirable as through its use each gallon of water fed to the boiler contains correct material for hardness precipitation and sludge conditioning. Proper balance of chemicals should also be present in the chemical treatment when applied continuously to the feed water at the heater or feed pump so that scale prevention is obtained in the feed lines as well as in the boiler.

FARRINGTON *Discussion*

(*Continued from page 41*)

on No. 10 and 11 stands were completed we dummied the other stands one at a time so that the other motor room work could be done. When these changes were completed we took out No. 5 mill, leaving us with a nine-stand mill. There were massive concrete foundations to be moved, and due to the proximity of the motor room and many delicate instruments and pipe lines, no heavy blasting could be done. Our heaviest crane had a capacity of 50 tons. Mr. Farrington gave us orders that the maximum lift we could make with this crane was 125 tons. I am afraid to say, even at this late date, what the weights of some of these pieces of concrete were that we lifted with this crane, because if I told the truth I am afraid that the electrical department would never trust me again. We split our old foundations, which we were removing, by means of liquid air and then cracked them completely in two with a small charge of about one-half stick of dynamite. As you can imagine, the working space was very tight and some of the foundations we removed would not have more than an inch or so clearance between the various pipe lines and conduit tunnels. Due to the craft of the engineering, electrical, mechanical and construction departments our work moved along very satisfactorily with practically no delays to operation. Any major change-over was done on our back-up roll change day which in our schedule of operations comes every tenth day. Three days before we went down for the major change over we took out No. 6 mill, leaving us with an eight-stand mill. We grouped our orders so that this change would not interfere with operations, although rolling light gauge on an eight-stand mill made our rollers age quite rapidly. Of course there was much other furniture added to the mill at this time; more hydraulic capacity and much mill furniture. When we finally went down on October 23, 1940 the details of tying the whole thing together had been carefully worked out and there were remarkably few bugs to be taken care of when we started operations again after eight days.

PHOS-COPPER *Brazing* OF *Armature Coils*

. . . . a development resulting from the drive for tin conservation, this brazing process is said to result in a stronger, positive joint . . . .

by C. Lynn, MANAGER
D-C GENERATOR ENGINEERING DEPARTMENT
WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY
EAST PITTSBURGH, PENNSYLVANIA

▲ SOLDER has been universally used for making the connections between armature coils and commutator necks and between armature cross connections and armature coils on direct current motors and generators since the development of d-c machines. Solder has been used because soldered joints are easily made and provide good contact when correctly made. Until very recently, no other commercially satisfactory means had been developed for making these joints. Soldered joints have three fundamental imperfections: (a) The joint is relatively weak mechanically, the strength decreasing very rapidly with increasing temperature due to the nature of the material, (b) the joints will not stand very high temperature since ordinary solder (50-50 solder) melts at approximately 183 C and, (c) there is no known way of telling whether a good soldered joint has been made.

On some machines and on practically all machines with class "B" insulation, which includes all railway equipment, these joints have been made with pure tin instead of solder on account of the higher temperatures at which these machines operate. Since tin melts at 232 C, higher operating temperatures can be employed when it is used.

After our country's entry into the war, a drive was made to conserve tin on account of its scarcity and the writer's company started developing a brazed type of joint for these connections. Similar efforts made in years past were never successful in developing a method that was commercially practical for large scale production. Brazing with a flame is impractical on account of the spread of heat and accompanying damage to adjacent parts, particularly to the insulation. This has, however, now been accomplished for commutators with open type necks.

Figure 1 shows the various types of commutator necks employed on our d-c machines. A and B show standard types of construction used on soldered joints; A is most commonly used. Note that in the case of A the neck is made of a double thickness of copper with the outer periphery opened to form a space for the insertion of the armature coil ends. This neck may be of two pieces, riveted or spot welded together, or may be of one piece folded to give two thicknesses. The second type shown in B is also used when the commutator bar pitch is very thin, in which case only a single thickness of neck material is used, with an additional piece riveted on, to form an opening, at the outer periphery for the armature coil ends. The soldering of these types of necks is similar and it is necessary to use filler pieces of copper of the same thickness as the armature coil ends, between the top and bottom armature conductors and in the opening below the bottom armature coil end.

Sketch C shows a type of brazed joint in which the armature coil ends are simply brazed to the standard type of neck, as used with the soldered joint. However, the copper filler pieces have been omitted below the bottom conductor coil end and between the top and bottom coil end. In brazing this type of joint, thin

strips of phos-copper* approximately 0.015 in. thick with a width equal to approximately half the width of the neck in a direction parallel to the shaft, are inserted between each side of the armature coil ends and the neck. Heat, from a brazing transformer, is then applied with pressure to the joint by means of carbon tipped brazing tongs. After the phos-copper has melted (815 C) and has flowed over the surface to be brazed, the current is stopped but the pressure is maintained till the joint cools. In normal production, a blast of compressed air is applied directly to the joint whenever current is not flowing. Thus, when the circuit is interrupted at the end of the melting period, this air tends to rapidly cool the brazed joint. An improvement that has been developed consists of blowing a small stream of air in a radially-inward direction against and between the armature conductors just back of the commutator necks. This keeps the conductor cool; eliminates damage to insulation. In making a joint in this manner, it is possible to braze armature coils with class "A" insulation without damage to the insulation. Since the armature conductors are brazed solidly to the commutator necks, no spacers are necessary between conductors or below the bottom, since it is not necessary to fill this space with brazing material. It should be pointed out

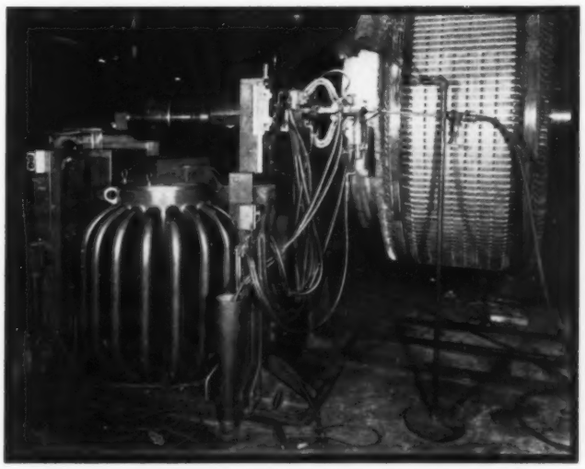


Figure 2 — Equipment for brazing armature coils to commutator necks using phos-copper and tong method.

that the resistance of a brazed joint is somewhat higher than that of a "good" soldered joint due to the inherent higher resistance of the material itself. However, since the resistance of either joint is a few micro-ohms only, the value is of no consequence.

Sketch D shows another type of brazed joint similar to the type shown in E. In D two pieces of copper are brazed together to form the neck. This method is used where the neck material has already been made, or where the necks have been partially formed in the shape shown in A, and have then been re-formed to that of Figure 4.

*Phos-copper is an alloy of phosphorus and copper and is used as a brazing material for copper and copper base alloys. It has a low melting point and is free-flowing.

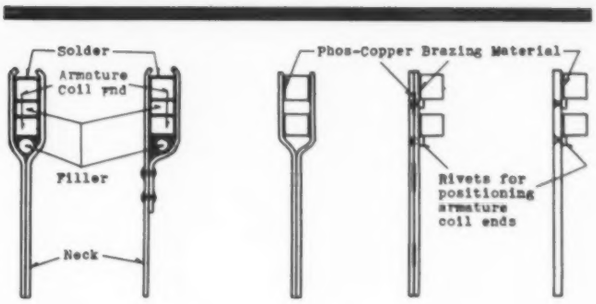


Figure 1 — D-c generator and motor commutator neck constructions. A — Standard double thickness open neck with soldered joint. B — Standard single thickness open neck with soldered joint. C — Standard double thickness open neck with brazed joint. D — Modified double thickness, neck with brazed joint. E — Standard single thickness neck with brazed joint.

In E, the neck itself is made of one piece of copper, with thickness equal to the total thickness of the soldered type neck shown in A or B. This thickness, of course, varies with the design and current rating of the machine. In this construction small copper rivets are inserted in the neck (in the correct position before the necks are attached to the commutator bars) to properly locate in a radial position, the ends of the armature coils for brazing. It is also possible to omit these small rivets and simply locate the position of the armature coil ends, radially, by reference to the outer periphery of

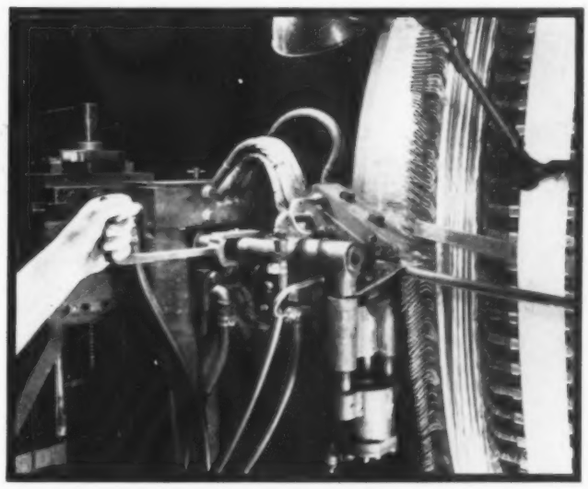
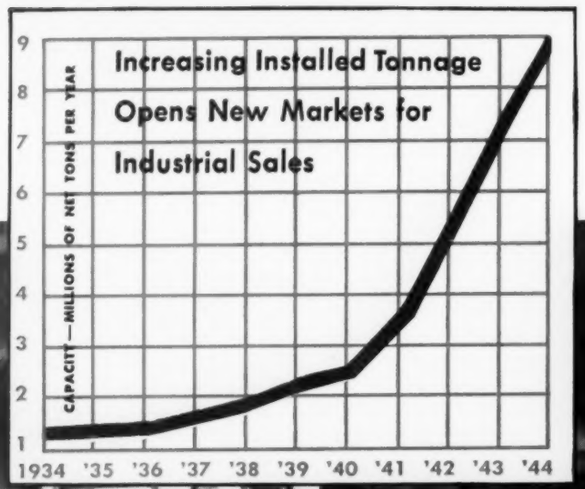


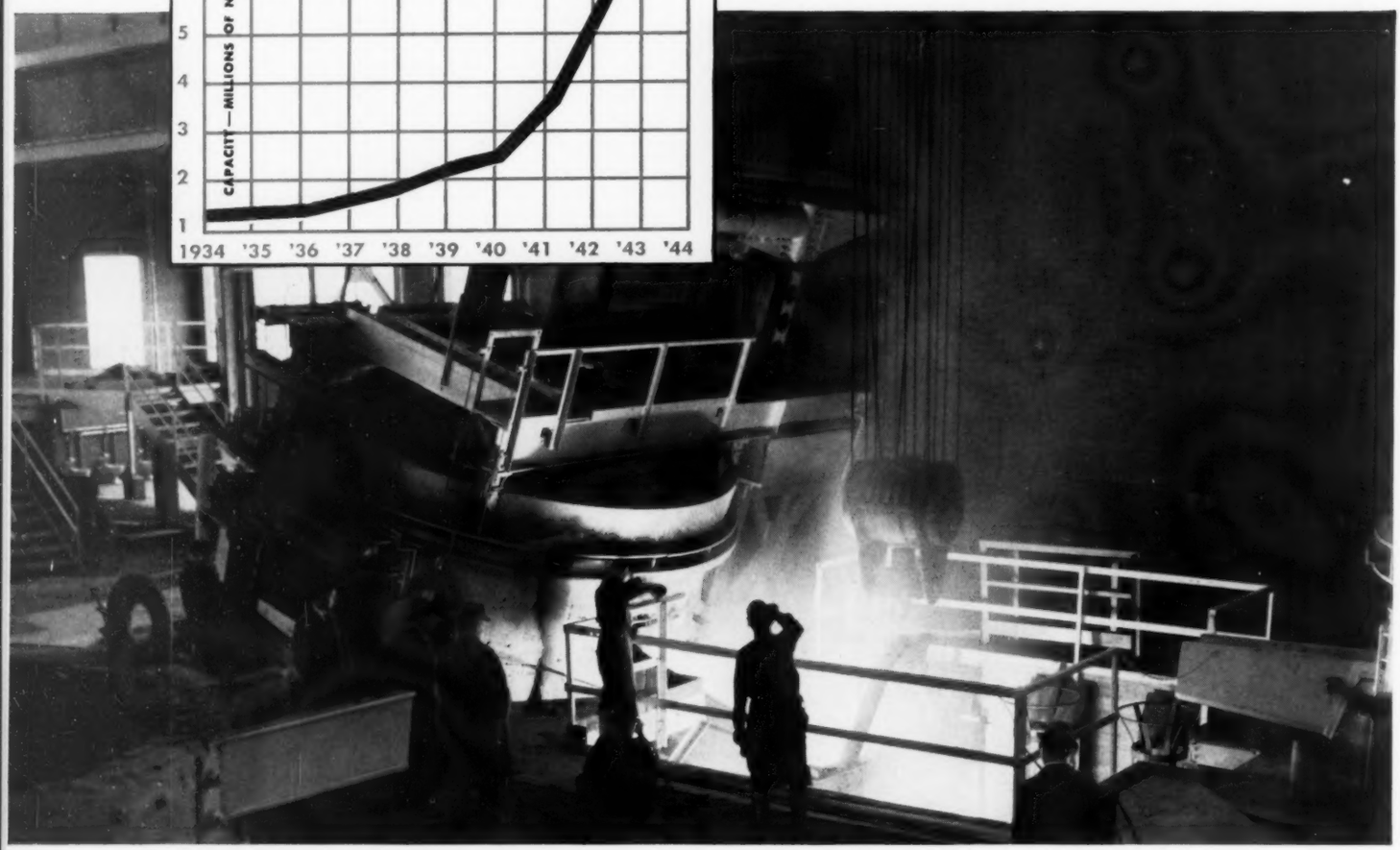
Figure 3 — Tong brazing with phos-copper showing close up of head in operation.

the armature iron, through use of a straight edge. Small pieces of phos-copper (approximately 0.015 in. thick and about half the area of the overlapping of an armature coil end on the neck) are spot welded to the neck to prelocate the brazing material. This provides the exact amount of brazing material necessary for brazing the joint. Too little or too much phos-copper brazing material results in an inferior joint. After the necks are

(*Please turn to page 86*)



IRON & STEEL



Typical products bought in substantial quantities by Electric Arc Furnace operators

Alloys
Aluminum
Arc furnaces
Arc furnace controls
Burned lime
Carbon products
Charging boxes and cars
Charging buckets
Charging machines
Circuit breakers
Cleansing agents
Copper bus bars and tubes
Copper castings
Copper lead cables
Doors and frames
Dolomite, raw, roasted and synthetic
Drying machinery
Electrodes, graphite and carbon
Ferro-alloys
Fluorspar
Fluxing materials
Graphite products
Hot tops
Ingot buggies
Ingot moulds and stools
Instruments
Insulating brick
Insulating materials
Ladles
Ladle cranes
Limestone
Motors and control
Mould washes
Nickel
Nozzle brick
Recarburizers
Refractory brick
Refractory cement
Refractory ramming mixtures
Refractory specialties
Silica sand
Sintering machinery
Slag thimbles and cars
Stopper and sleeve brick
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See back cover for detail on rates and circulation.

IRON & STEEL ENGINEER

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prepared in this manner, they are brazed into a slot machined in the bar. Before brazing was used for attaching the necks in the bars the necks were held in position in the slot in the bars by soldering and riveting with counter-sunk rivets. For the past two and a half years we have eliminated this riveting and soldering and have simply brazed the necks into the slots.

Tong brazing with phos-copper is well suited to making multiple-joints as encountered on commutator necks and armature coil-ends, because it does not require a bright surface for the work. Flux, which may cause damage to adjacent insulation, cause corrosion of the metal and peeling of varnish and paint is not needed. Even copper which has been tinned or soldered can be brazed, if phos-copper brazing material is used.

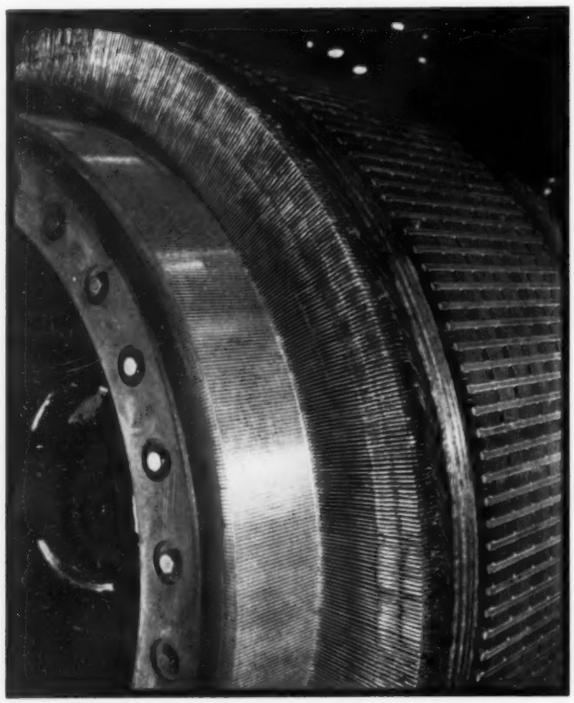


Figure 4 — Completed armature after the coil-neck joints have been brazed with phos-copper.

At room temperatures, the phos-copper joint is approximately four times as strong as a perfectly-formed soldered joint, using pure tin. With an increase in temperature, the phos-copper joint becomes many times stronger than a tinned or soldered joint. Then, too, the brazed joint can be taken apart when desired by applying heat through use of the tong, and simply separating the pieces while hot.

In making armature coils for soldered joints, ends of the coils are pretinned after the coils are formed and before they are treated in varnish. After the coils have been treated in varnish, the varnish is removed from the ends by dipping into a pot of melted tin or solder. When soldering with pure tin, the pretinning must be done with pure tin also, so as not to contaminate the final pure tin joint with lead. It is absolutely necessary to pretin the ends of the armature coils before making a soldered joint. It is also necessary to pretin the open ends of the commutator necks before soldering the armature coils to the necks.

When brazing is used, no tinning of any kind is necessary on the open end of the commutator necks. The armature coils, however, are pretinned and retinned in exactly the same manner when the coils are to be brazed as when they are to be soldered, except that pure tin need not be used. Attempts to eliminate pretinning and retinning of the coil ends (by various other methods for removing varnish from the coil ends such as sand blasting, acid treatment, etc.) have uncovered no method that compares, in ease and cheapness, to that of removing the varnish by tinning. Phos-copper brazing material is ideal since it will braze even with the coils tinned or covered with a thin amount of solder. Not only does it permit following through on the manufacturing program but also permits brazing armature coil-ends and commutator-neck joints, which have previously been soldered. In such cases, it is only necessary to split the joints, heat the material, remove (with a rag or other means) the bulk of the solder from the copper, place pieces of thin phos-copper strips in the joint (in the manner mentioned under the brazing of the type shown in Figure 1A) and braze the joint.

We are continuing experiments and development work on brazing technique in order to improve brazed joints and cut down the time required to make them. At present, it takes somewhat longer to make brazed joints than soldered joints. Eventually, it is hoped that it will be possible to make brazed joints as quickly as soldered joints. The application of phos-copper has been tried in other forms than by spot facing thin strips to the necks. One such method used phos-copper as a plating put on in the form of a metal spray. In this case, the surface of the neck had to be sand blasted (or roughened in an equivalent manner) in order to get the phos-copper to stick to the neck.

In our shops, brazing stands are used for work on the commutator necks. These stands consist of roller bearing supports, adjustable in height and spacing, to support the rotor by means of the shaft. This permits the armature to be placed in correct relationship to the brazing head and permits easy turning of the rotor, bringing different joints successively to the head. The brazing head itself consists of air operated "tongs" having parallel moving jaws. They can move inward or outward, in a radial direction along the commutator neck, for brazing the outer or inner armature coil ends. They can also move in an axial direction to permit insertion of the carbon jaw tips used for gripping the joints to be brazed. The carbon tips are thin and tapered and each is connected to the brazing transformer through suitable flexible leads. These tips can be shaped to any size required, depending upon space available between necks and size of necks and coil ends. It is necessary to bend adjacent necks slightly away from the neck being brazed. Some difficulty in bending may be encountered on extremely short necks. The neck being brazed lies in a horizontal position. By means of a lever, the carbons are positioned above and below the joint. A lever is pressed with the foot which admits air to a hydraulic cylinder and presses the carbons together. Current is applied by further travel

of the foot lever. A continuous small stream of compressed air, blowing from a fixed orifice adjusted to the correct location for the particular armature, blows against the armature coil just back of the neck, keeping it cool and eliminating damage to insulation. When the prelocated phos-copper, previously spot-welded to the neck, melts and flows out over the joint to be brazed, the operator releases the switch, stopping the current flow. However, he still maintains pressure on the joint. When the circuit is interrupted, an additional air blast blows through a hose and small orifice near the tip of the jaws, cooling the joint quite rapidly. In a very few seconds the phos-copper will have hardened and the jaws can be released. See Figure 2 and 3.

To break one of these joints the process is reversed. The joint is heated with the tong and as soon as the brazing material starts to flow, the current and pressure are released and the two pieces are knocked apart. It is possible to make and remake a joint 3 or 4 times without adding brazing material. Brazed joints made as replacements for soldered joints, using the type of construction shown in Figure 1-C, are somewhat more difficult to open. Those made as shown in Figure 1-D and 1-E are very easily opened. Figure 4 shows the commutator end of a rather large armature whose armature coils and commutator necks have been phos-copper brazed, using the latest type of neck as shown in Figure 1-E.

For use in the field or in manufacturing and repair shops such elaborate equipment is, of course, not needed nor justified. A portable type of brazing transformer equipment, with adjustments for varying the value of the brazing current, is satisfactory. Such portable equipment is available and includes a set of brazing tongs with carbon tips attached to the jaws. Figure 5 shows such an equipment in use, while Figure 6 shows a closeup of brazing with the tongs.

Approximately 125 to 250 joints can be brazed with one set of carbon tips. Since the tips are small and inexpensive, the cost of carbon tip replacement is low. The portable brazing set not only includes a set of brazing tongs but also has connections for air supply, with suitable valves. These magnetic valves operate automatically in the proper sequence and supply the air to the joints being brazed whenever the current supply is opened. All that is necessary is to connect an air supply to the connection provided on the transformer case. This equipment is mounted on wheels to make it readily portable.

On the armatures of d-c machines, there are cross connections between points of equal potential, usually two pole pitches apart. Cross connection joints are ordinarily spaced approximately 2½ in. apart around the armature periphery and are normally located at the rear of the machine. The standard method of joining

Figure 6 — Close up of portable brazing tongs in action.

cross connections to armature coil clips has been by riveting and soldering. When using brazed joints for these connections, the riveting can be omitted. The cross connector can be brazed to the armature clip in the same manner used for commutator necks. In factory production, the brazing material (in the form of thin strips) is attached to the armature coil clips by means of spot welding, before winding.

Phos-copper brazing can be applied not only to commutator neck and cross connections but to many other jobs as well. It can be used on stators of a-c machines, on induction regulators, transformers, etc. It is not necessary to prelocate the brazing strip material since it can be fed to the work in the form of small rods about ⅛ in. in diameter. In d-c machines, we have used phos-copper brazed joints for attaching cross connection clips to armature coils themselves for the past fifteen years. Never has there been a single failure of this brazed joint. Similarly on the stators of d-c machines, phos-copper brazing on leads from brushholder brackets to brushholder cross connection rings, have been used for fifteen years without any failures.

Figure 5 — Portable tong brazing outfit being used to join armature coils to necks.

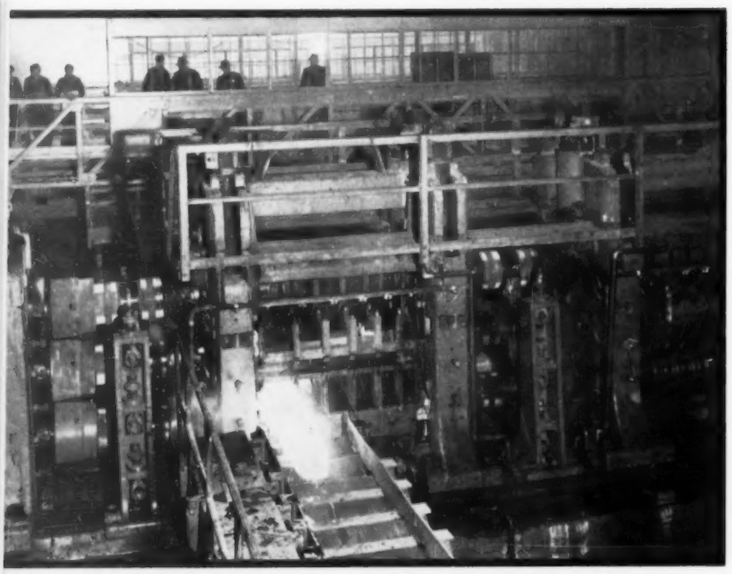
New 24-21 INCH *Mill* NOW IN OPERATION AT *Copperweld*

. . . . this bar mill is designed to handle a wide range of sizes in small orders without excessive lost time for mill changes . . . .

▲ ANOTHER unit in the new expansion of steel producing facilities built under DPC sponsorship by the Copperweld Steel Company at their Warren, Ohio plant is the new 24-21 inch rolling mill.

The new rolling facilities are provided by a 24-21 inch bar mill, of a design offering considerable flexibility of operation. The 24 inch train consists of three stands side by side, spaced 14 feet and 12 feet 7 inches apart and driven through a gear set of 5.2:1 ratio by a 1400 hp, 405-600 rpm, 2300 volt Kramer drive. The first two stands are three-high and have roll faces of 66 inches, while the third stand, two-high, uses a roll with a 54 inch face. About 130 feet distant is the 21 inch train, consisting of four stands side by side. The first three stands, which are three-high and use rolls of 60 inch face, are in line with the three stands of the 24 inch mill, while the fourth stand, two-high and with a roll face of 48 inches, is placed 10 feet 9 inches to the side. The 21 inch train is driven direct by a 2500 hp, 0-50-100 rpm, d-c motor under variable voltage control, receiving power from a 3000 kw, 600 volt motor generator set.

Blooms ranging 7-10 in. square may be reduced to sections as small as 4 in. square in tho three stands of the 24 in. mill.



The mill tables, the rollers of which are on 3 feet 6 inch centers, operate at speeds of about 500 fpm and are connected to each adjacent table by transfers. Traveling tilting tables are installed on each side of the 24 inch mill train, while stationary tilting tables are provided on the down-mill side of the 21 inch train.

About 150 feet beyond the 21 inch mill train is a hot saw, and 50 feet farther there is a hot bed approximately 135 feet long and 40 feet across. On the other side of the hot bed, a run out table containing a vertical shear proceeds about 100 feet to a kick-off and cradle.

With this arrangement, either mill train can be used independently, or they may be used in conjunction in almost any combination. Blooms ranging from 7 inches to 9½ x 10 inches are rolled down to as low as 4 x 4 inches on the 24 inch mill or down to 3½ inches square on the 21 inch mill. The production rate averages about 30 tons per hour.

One continuous furnace, rated at 50 tons per hour, with hearth dimensions 60 feet x 22 feet, heats steel for this mill. Of triple zone design, the furnace is fired with natural gas through eight burners in each zone. Oil is available as a standby. Of the 60 feet of effective length, 8 feet is devoted to a preheat zone ahead of the furnace flues, and 12 feet 6 inches is devoted to soaking zone. Air for combustion is preheated in a silicon-carbide tubular recuperator.

Other units in the expansion program are just going into operation and it is expected that news of these final units of the project will be available soon.

THERE are many steps between planning and completion of your ore beneficiation plant. McKee handles *all* of them under a *single contract* which places undivided responsibility in one organization.

This method, proved in 38 years of service to the Iron and Steel Industry, not only saves manifold negotiations, but eliminates overlapping responsibilities and duplication of effort.

Our ore beneficiation experience combined with thorough knowledge of Blast Furnace and Open Hearth requirements enables us to determine correct plant design and proper correlation of crushing, screening, concentrating, blending, and sintering equipment for producing beneficiated materials with physical properties best suited to your particular requirements.

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★ *Engineers and Contractors* ★

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COMMERCE BUILDING
HOUSTON, TEXAS

. . . "BUSS Fuses have kept our Cupola Blower Operating without a Needless Shutdown

. . . formerly we had an average of two outages per month,"

Says

ELECTRICAL MAINTENANCE SUPERINTENDENT

KARL MOEHLMAN

of Gisholt Machine Co., Madison, Wisconsin

"From a production standpoint," continues Mr. Moehlman, "probably the most important circuit in our plant is for a 50 horsepower, 220 volt, 3-phase motor operating a cupola blower. This blower simply *must not* fail, otherwise serious production loss occurs, involving damage to critical material.

"This particular circuit was blowing fuses at an average rate of twice a month, until we switched to BUSS Super-Lag fuses more than six months ago. Since the change, not a single fuse has been blown."

Why BUSS Fuses Don't Blow Needlessly

10 FEATURES in the design of the FUSE-CASE help make it possible. . . .

and

***The* SUPER-LAG** development in the FUSE-LINK completes the job.

BUSS

Can Mr. Moehlman's experience at Gisholt suggest to you a way to eliminate needless production shutdowns due to fuses opening needlessly? His experience is like that of many others who have found that the long time-lag of BUSS Super-Lag fuses prevent needless shutdowns due to harmless overloads. Yet these fuses give you the protection you need when serious trouble occurs.

Buss fuses require no maintenance or periodic inspection. They don't open needlessly. If one opens, you can be sure some condition needs correction. When one opens, it requires less than 45 seconds to renew with an inexpensive link.

Here is why BUSS fuses greatly reduce or entirely prevent needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a long time-lag so that unusually heavy starting current or other harmless overloads will not cause the fuse to blow.

How to solve the "shutdown" problem

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses afford.

BUSSMANN MFG. CO., University at Jefferson, St. Louis 7, Mo.
Division McGraw Electric Company

Super-Lag FUSES

SOLD THROUGH WHOLESALERS

Wagner

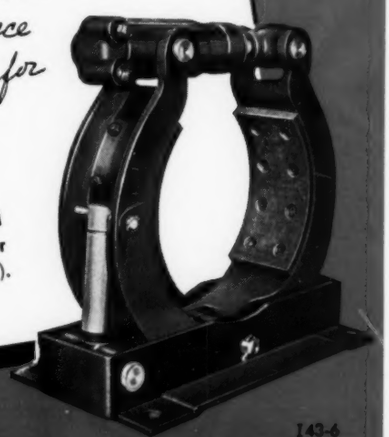
HYDRAULIC BRIDGE BRAKES

make crane operation safer and easier—

as expressed in the letter reproduced below, received from a mill worker employed in the plant of a well-known company.*

Wagner Electric Corp.,
St. Louis, Mo.

Dear Sirs: Recently a Wagner hydraulic brake was installed on a over-head crane I operate. This brake transformed my job from a nerve wracking grind, to a pleasant days work. No more brake chatter and vibration, which caused a break down ever so often, holding up production, as well as a tired out sick feeling at the end of every shift. With the Wagner hydraulic brake, I now can come to a smooth as well as an emergency stop; and depend on it to do just that. Anyone who operates a crane with a fairly fast run way speed, and averageing 300 lifts per shift would appreciate how important this is. After a dozen years of this work I find I enjoy doing it, thanks to your brake. Your company as well as mine are to be congratulated. You for building a fine piece of machinery, and my employer, for using the best.



I43-6

*Name and address of writer will be sent upon request. (This letter is reproduced exactly as written).

Write for Complete Information . . .

Bulletin IU-20 gives full information on the two available types of Wagner Hydraulic Bridge Braking Systems—type H for inside cranes, and type HM for outside cranes where automatic parking is necessary.

Wagner Hydraulic Bridge Braking Systems are complete in every detail, including all necessary parts and equipment, and are ready for immediate installation on your cranes.

Wagner Electric Corporation
ESTABLISHED 1891
6483 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

STALWART, WAR-TIME POWER

American-made motors and generators have met the two and three shift requirements of war industry, with an astounding record of trouble-free performance.

A sizeable proportion of these bear the Crocker-Wheeler name . . . quite a few of them are *older* than the operators of the machines they serve. For Crocker-Wheeler motors and generators, for over 50 years, have been carefully and durably built.

CROCKER WHEELER ELECTRIC MANUFACTURING CO.
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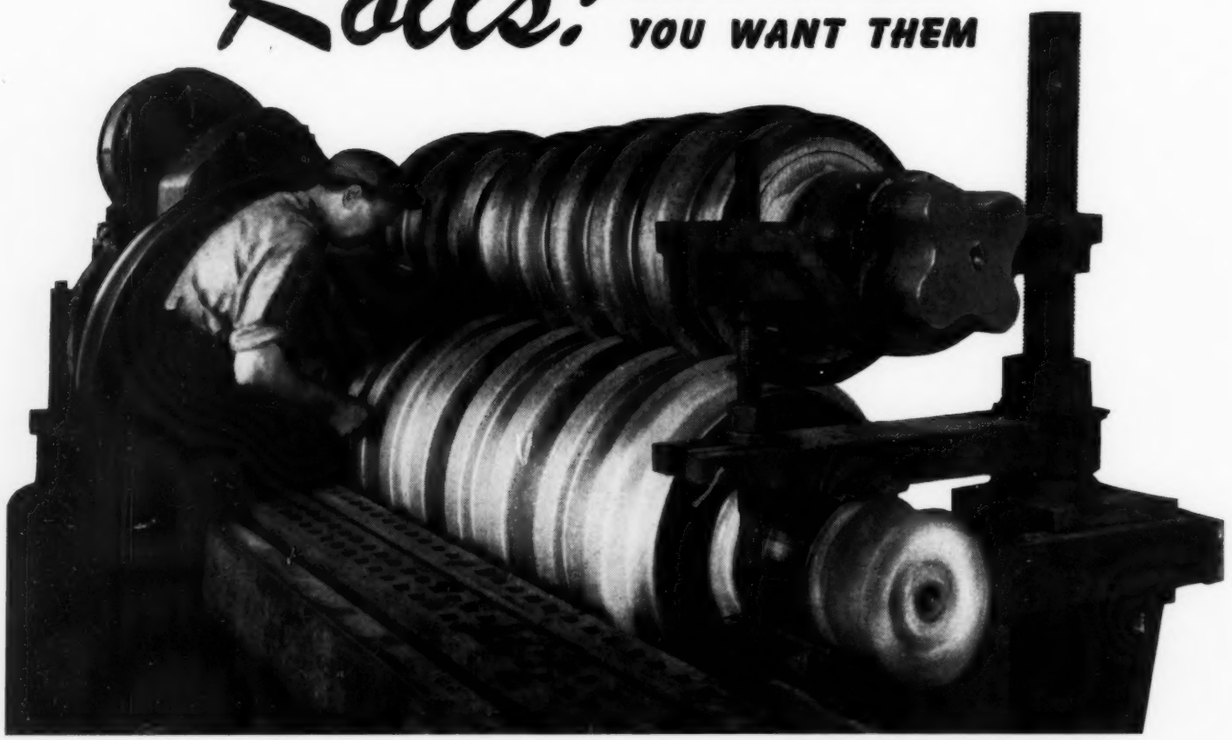
Other JOSHUA HENDY IRON WORKS factories at Sunnyvale, Pomona, Torrance, and Long Beach, California, and St. Louis, Mo.

Rolls: MADE THE WAY YOU WANT THEM



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Individualized Roll Service

● Individualized service is the keynote of all Birdsboro roll engineering work. That means solving *your* specific problems—not just the general problems of the industry.

Each Birdsboro roll is tailored to that *right* combination of analysis and physicals which does the job best. As a result, Birdsboro rolls give greater tonnages, more rolling accuracy—longer *uninterrupted* production.

Don't you think it would be sound business to consult Birdsboro on that next roll job?

THESE ARE THE ROLL TYPES WE MAKE

Carbon Steel
Birdsboro "30"
Birdsboro "40"
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Diamondite
Durite
Chilled Iron
Grainloy
Superloy
Curoloy

For blooming mills, billet mills, structural mills, bar mills, rolling mild, structural steel, gun barrel, seamless tube and special alloy steels. Also for 4-high strip mill back-up rolls and 3-high sheet rolls.

BIRDSBORO STEEL FOUNDRY & MACHINE COMPANY • BIRDSBORO, PENNSYLVANIA

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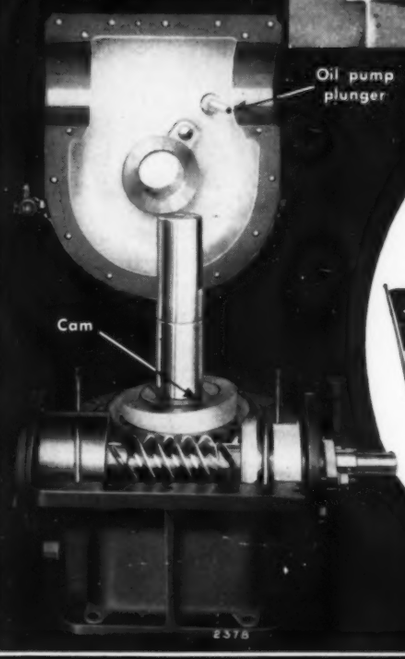
DE LAVAL
WORM GEARS
require little attention

Tow-boat capstan driven from De Laval worm gear . . .

Motor drive through De Laval vertical drive worm gear and spur gear to capstan.

Vertical drive worm gear with cover lifted.



The two working parts are enclosed in a moisture- and dust-proof housing and run in a bath of oil. Where splash lubrication is not dependable, an oil pump is provided, as for the upper bearing of the vertical shaft drive here shown. No attention is required other than to check the oil level at long intervals.

Power is transmitted by a continuous, shockless, wedging action, with contact at all times between three or more pairs of teeth, which are subject to compression rather than bending.

The case-hardened steel worm, the wheel of bearing bronze and copious lubrication insure high efficiency, long life and unequalled reliability.

Describe requirements and ask for Publication W-1137.

DE LAVAL
WORM GEAR DIVISION
of the De Laval Steam Turbine Co., Trenton, N. J.

MANUFACTURERS OF TURBINES STEAM, HYDRAULIC, PUMPS CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, CLOGLESS, SELF-PRIMING CENTRIFUGAL BLOWERS and COMPRESSORS, GEARS WORM, HELICAL, and FLEXIBLE COUPLINGS

MISSING

...yet still in action

For years, Manson Tape has occupied the highest position of all friction tapes. Whenever the utmost safety and permanence in splice protection was required, Manson Tape became the first choice of experienced engineers and electricians. Purchasing agents, too, willingly paid more to get lasting protection.

Contributing to this fine reputation of Manson Tape was the pledge of The Okonite Company to use only the best materials in its manufacture. One of these materials was a special type of natural rubber, which thoroughly impregnated and coated the strong, closely-woven cotton fabric. The exclusive use of this special type of new rubber was one reason why Manson Tape was unequaled in true adhesiveness and in aging and weathering qualities.

Today, with *all* new rubber forbidden for this use, the manufacture of Manson Tape has been temporarily discontinued because, if made with the materials currently available, Manson Tape would not have the superior characteristics nor be of the same high quality that you have always known.

As an assurance to the thousands of electrical men who have so consistently used it, we remind them that older joints and terminals made with Manson Tape will stay protected for years to come. To those who are fortunate enough to have available a supply of Manson Tape, we suggest it be reserved for the most important jobs.

UNTIL MANSON TAPE IS AGAIN AVAILABLE

We recommend as an alternative, *Dundee "A" Friction Tape* which fully complies with all current Federal and A.S.T.M. emergency specifications.

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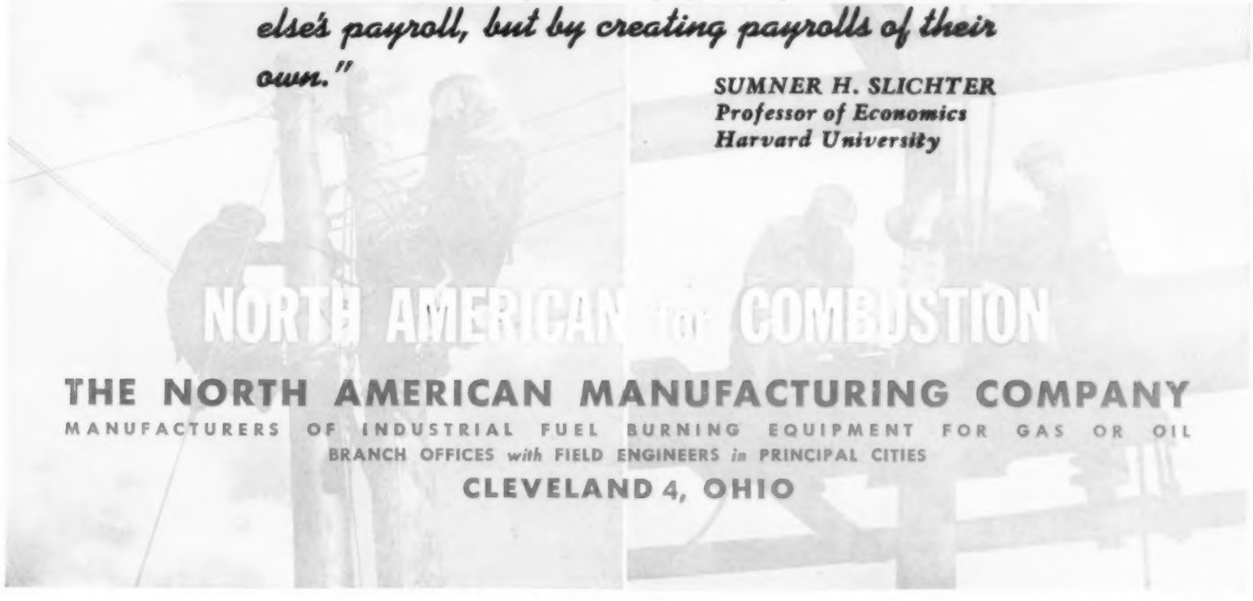
JOBS IN PEACE TIME

To get music you encourage musicians . . . .
To get paintings you encourage artists . . . .
Jobs are made by men of daring, initiative and creative thought who risk something in starting a project . . . men who then contract with others to help bring their ideas to fulfillment.

". . . the nation which wishes to be great, must place enterprise ahead of security. It must regard innovators, experimenters, starters of enterprises, as peculiarly useful citizens and go out of its way to furnish them a congenial and hospitable environment . . . It must strive to increase the proportion of its citizens, who become experimenters and innovators and who make their living, not by getting on someone else's payroll, but by creating payrolls of their own."

SUMNER H. SLICHTER
Professor of Economics
Harvard University



THE NORTH AMERICAN MANUFACTURING COMPANY
MANUFACTURERS OF INDUSTRIAL FUEL BURNING EQUIPMENT FOR GAS OR OIL
BRANCH OFFICES *with* FIELD ENGINEERS *in* PRINCIPAL CITIES
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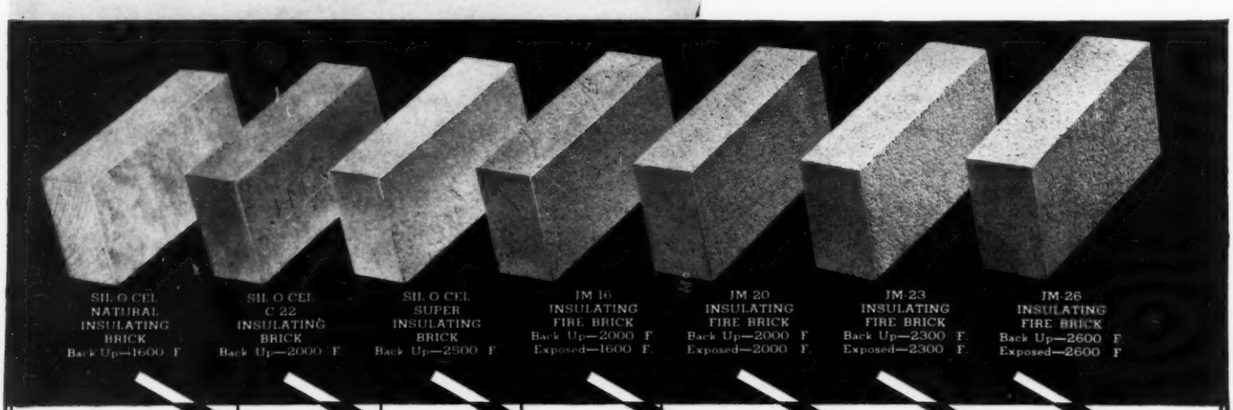
PHOTOS BY LAMBERT

THE *RIGHT* BRICK for EVERY TEMPERATURE ...for EVERY SERVICE

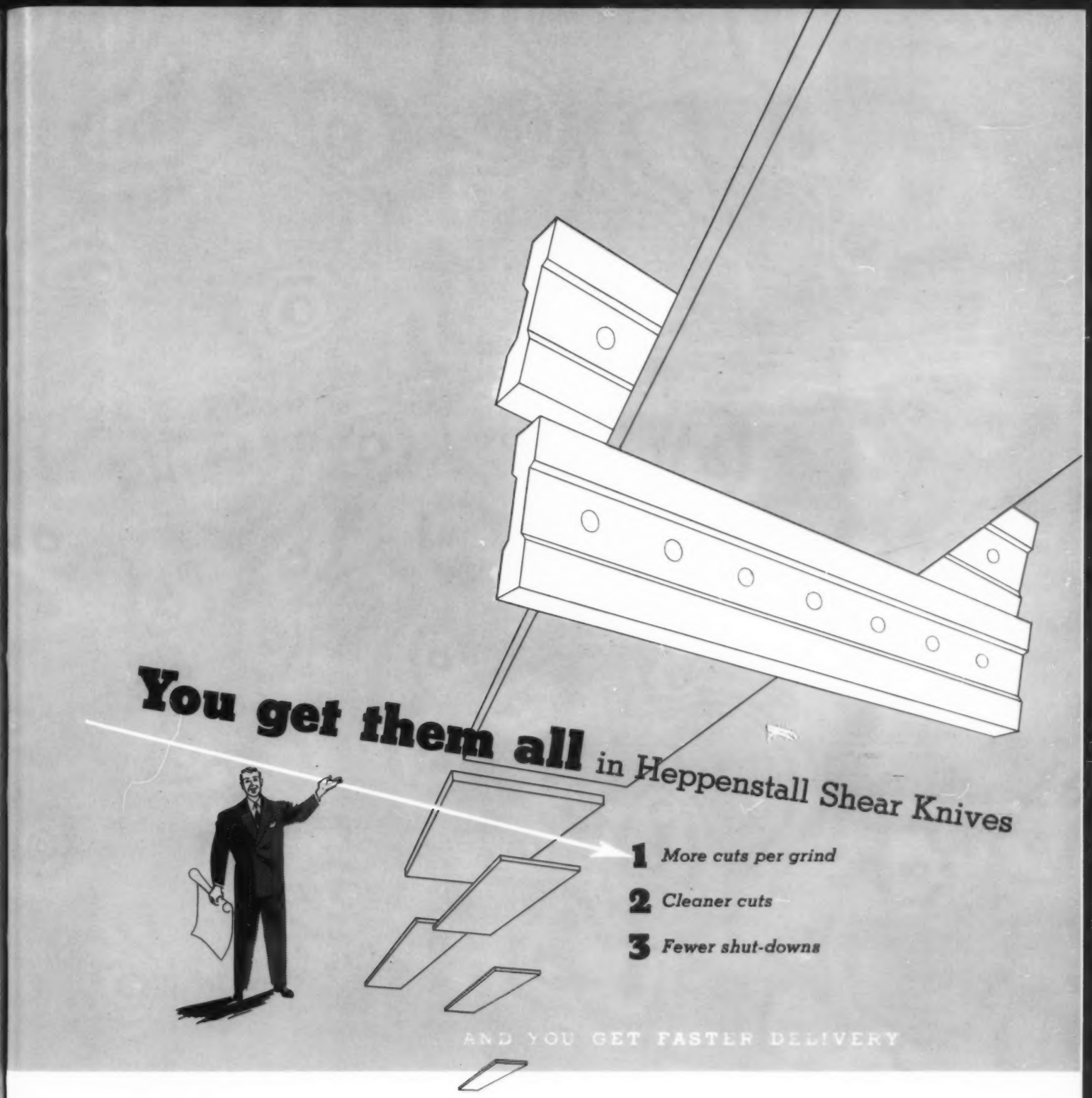
Listed below are details on the properties of the complete line of J-M Insulating Brick and Insulating Fire Brick. Each is designed for a specific temperature and service . . . can be relied upon for continued efficiency and economy. For further details, write Johns-Manville, 22 East 40th Street, New York 16, N. Y.


SIL-O-CEL NATURAL INSULATING BRICK Back Up—1600° F
SIL-O-CEL C-22 INSULATING BRICK Back Up—2000° F
SIL-O-CEL SUPER INSULATING BRICK Back Up—2500° F
JM-16 INSULATING FIRE BRICK Back Up—2000° F Exposed—1600° F
JM-20 INSULATING FIRE BRICK Back Up—2000° F Exposed—2000° F
JM-23 INSULATING FIRE BRICK Back Up—2300° F Exposed—2300° F
JM-26 INSULATING FIRE BRICK Back Up—2600° F Exposed—2600° F

Properties							
Density—lb. per cu. ft.	30	38	40	22	31	38	44
Transverse Strength—lb. per sq. in.	140	115	90	70	100	135	150
Cold Crushing Strength—lb. per sq. in.	400	700	300	70	125	170	165
Linear Shrinkage—%	1.4 @ 1600° F	0.8 @ 2000° F	2.0 @ 2500° F	0.0 @ 2000° F	0.0 @ 2000° F	0.0 @ 2300° F	0.5 @ 2600° F
Reversible Thermal Expansion—Percent	0.1 @ 1600° F	0.7 @ 2000° F	1.29 @ 2000° F	0.5—0.6 @ 2000° F	0.5—0.6 @ 2000° F	0.5—0.6 @ 2000° F	0.5—0.6 @ 2000° F
Conductivity at Mean Temperature	∥ ⊥						
500° F	1.01 .67	1.67	1.70	.75	1.01	1.26	1.61
1000° F	1.13 .79	1.88	1.95	1.01	1.19	1.49	1.90
1500° F	1.24 .90	2.08	2.19	1.41	1.49	2.05	2.61
2000° F	... ..	...	2.45	...	1.91	3.37	4.29
Recommended Service							
Back Up	1600° F	2000° F	2500° F	2000° F	2000° F	2300° F	2600° F
Exposed	....	....	....	1600° F	2000° F	2300° F	2600° F
Recommended Mortar for Setting Brick	Sil-O-Cel Mortar	Sil-O-Cel Mortar	Sil-O-Cel Super Brick Mortar	J-M No. 1626 Cement	J-M No. 1626 Cement	J-M No. 1626 Cement	J-M No. 1626 Cement

Note:—1. Above tests are in accordance with ASTM tentative standards.
2. Conductivity is expressed in Btu. in. per hr. per sq. ft. deg. F. at the designated mean temperatures.
3. ∥—with heat flow parallel to brick strata.
⊥—with heat flow perpendicular to brick strata.

JM PRODUCTS Johns-Manville
INDUSTRIAL INSULATIONS


You get them all in Heppenstall Shear Knives
1 More cuts per grind
2 Cleaner cuts
3 Fewer shut-downs
AND YOU GET FASTER DELIVERY

Actual service is "the proof of the pudding" and almost 50 years of it have rather conclusively demonstrated the superiority of Heppenstall Shear Knives . . . As the world's oldest and largest manufacturer of solid tool steel knives, Heppenstall is able to offer greater precision in manufacture and prompt delivery.

To help speed your war work, Heppenstall offers you this free steel-weight calculator. Write now—the supply is limited.

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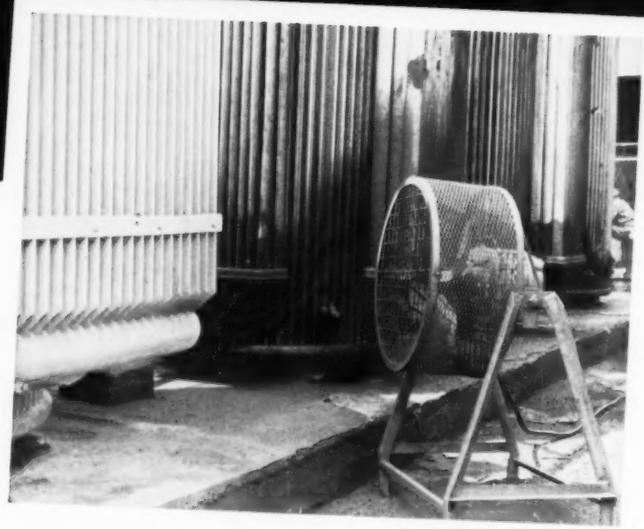
EDDYSTONE

Forging Fine Steels for Fifty-Three Years

Let Truflo Fans . . .

Help keep your workmen on their toes

Portable Fan No. TF-100, recognized as standard in many of the country's largest mills. Sizes from 12 in. to 36 in. in diameter.



Portable Fan No. TF-300 in operation, cooling large transformers in strip mill.

Crane Cab Fan, for cooling crane cab interiors and other confined areas. Available in 12 in. and 18 in. sizes, adjustable both horizontally and vertically.

Portable Fan No. TF-300W. Angle iron support adjusts for vertical or horizontal discharge through almost 360°.

It's more important now than ever before to keep your workmen comfortable. For comfortable workmen are more efficient, produce more work in a given time.

Truflo Fans can help you keep your workmen on their toes. All Truflo Fans are designed and built correctly for efficient, economical operation — they move more air per dollar. Write for free literature on any of the following styles:

Portable Cooling Fans • Crane Cab Fans
Wall Fans • Exhaust Fans • Blowers
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TRUFLO FAN COMPANY

554 MAIN STREET HARMONY, PA.

The new markets that were *"discovered"* at a convention

Four years ago, at the Exposition of Chemical Industries, we put up a trial balloon.

We exhibited a list of 34 chemicals from coal. Some of them were well known commercial chemicals. But others on this list had no sizable known commercial uses. Their general physical and chemical properties were known, but commercially speaking, they were "orphans."

We frankly said *that* about them four years ago; but we also pointed out that the organic chemical industry was growing by leaps and bounds, that it needed things it had never needed before, that other chemicals derived from coal had proven important raw materials for the chemical industry, and that perhaps one of the "orphans" in the Koppers' booth might be exactly the thing for which some chemist was cudgeling his brains.

Since then we have sent out literally thousands of samples of those chemicals. We have worked with many men who saw some promise in them.

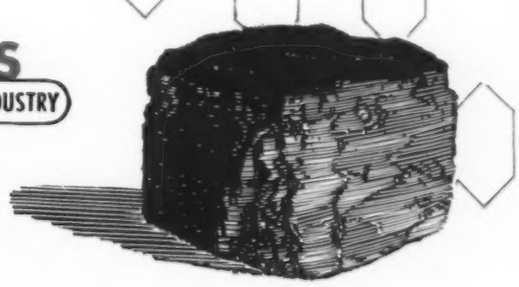
Today, several of them are in commercial production, and new plants have been built to recover them.

In early December, this year, the current Exposition of the Chemical Industries is being held. Koppers is there again to discuss possible applications of coal tar products. (There are over two hundred identified chemical compounds in coal tar and possibly many more not yet identified.) Who knows what stories may be told four years from now about coal tar chemicals which have no known use now?

Koppers is already serving the chemical industry by producing phenol, cresol, xylenol, pyridine, quinoline, and other tar bases, naphthalene, light oil products, ammonium thiocyanate, refined tars, industrial pitches, and many other products.—Koppers Company and Affiliates, Pittsburgh, Pa.

KOPPERS

THE INDUSTRY THAT SERVES ALL INDUSTRY

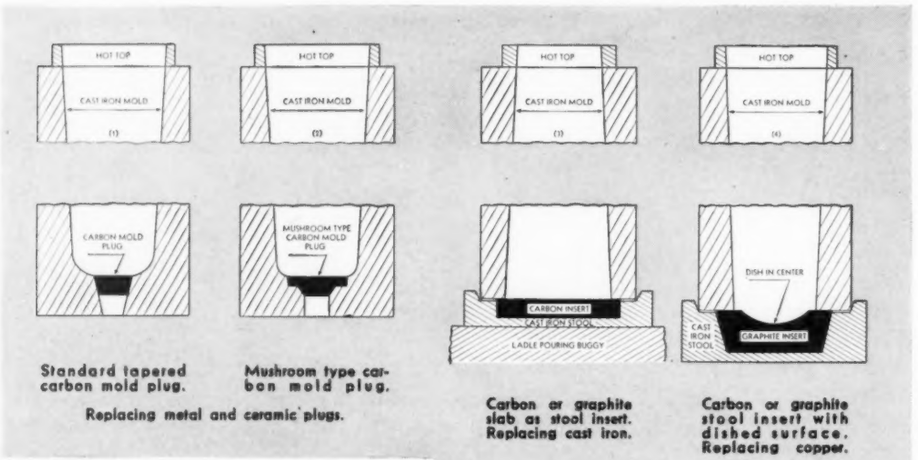


Where Severe Thermal Shock is a Factor

Use Carbon and Graphite

EXPERIENCE HAS PROVED THE STABILITY AND EFFECTIVENESS OF "NATIONAL" CARBON AND GRAPHITE PRODUCTS WHEREVER SEVERE THERMAL SHOCK IS ENCOUNTERED.

STRENGTH . . MINIMUM OF CRACKING, SPALLING AND STICKING . . FREEDOM FROM INCLUSIONS OF FOREIGN MATERIALS . . LIGHT WEIGHT . . LONG LIFE . . LOW COST



Standard tapered carbon mold plug. Mushroom type carbon mold plug. Replacing metal and ceramic plugs.

Carbon or graphite slab as stool insert. Replacing cast iron.

Carbon or graphite stool insert with dished surface. Replacing copper.

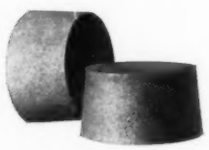
Graphite pouring block. Replacing cast iron and steel.

Solid carbon stool. Replacing cast iron and steel.

"National" Carbon, Graphite and "Karbate" products are successfully meeting many mechanical, electrical and chemical requirements in the metallurgical and process industries. They are available in many sizes and shapes, such as brick — beams — blocks — pipe, fittings and valves — for the fabrication of tanks — tank linings — pipe systems — heat exchangers — towers and other equipment for handling or processing corrosive materials. Write for complete information.

are important advantages offered by these materials in such applications as ingot mold plugs, stool inserts, stools and pouring blocks (see sketches of typical applications). Mold and stool life have been prolonged and other economies made possible.

STANDARD TAPERED MOLD PLUGS



Standard tapered mold plugs are available in two sizes:

$5\frac{13}{16}''$ x $5\frac{1}{4}''$ x $3''$

$5\frac{15}{16}''$ x $5\frac{9}{16}''$ x $3''$

Other sizes and shapes of mold plugs, as well as stool inserts, stools and pouring blocks can be supplied to meet any desired specification.

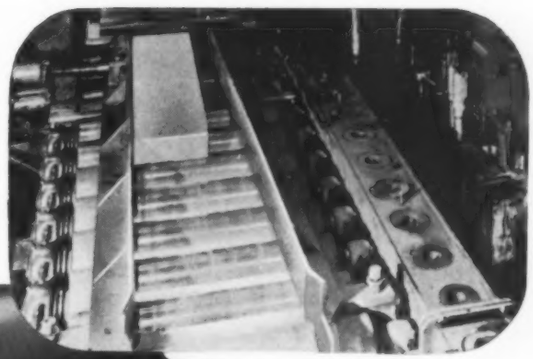
The words "National" and "Karbate" are trade-marks of National Carbon Company, Inc.

NATIONAL CARBON COMPANY, INC.
Unit of Union Carbide and Carbon Corporation
UCC
CARBON PRODUCTS DIVISION, CLEVELAND 1, OHIO
General Offices: 30 East 42nd St., New York, N. Y.
Branch Sales Offices: New York - Pittsburgh - Chicago - San Francisco

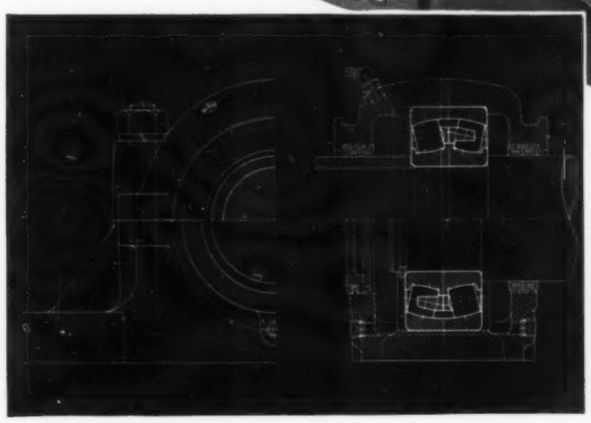
AN SKF PILLOW BLOCK
DESIGNED FOR TABLE ROLLERS
Exclusively

With the urgent need for speed in steel production today, operators can't take chances with table rollers slowing down because of bearing trouble. Bearings, to do their share, must be protected against lubricant leakage and the entrance of dust, scale and water. So SKF designed a sturdy, two-piece pillow block that fills the bill. Built to permit maximum load-carrying capacity in minimum space, this pillow block is readily adaptable for use with a central lubricating system... is equipped with the exclusive SKF Triple Seal. When the *Bearings* are protected, so is PRODUCTION. 5433

SKF INDUSTRIES, INC., PHILA., PA.



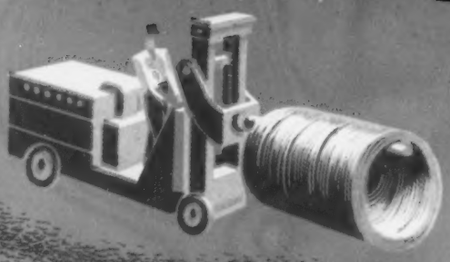
SKF
PILLOW BLOCKS

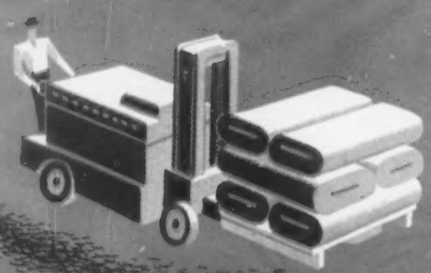


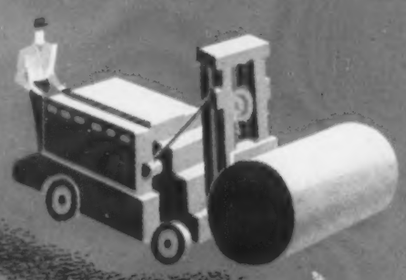
● *Adequately guarded by SKF Table Roller Pillow Blocks, SKF Spherical Roller Bearings provide compactness... rolling alignment to compensate for warpage, deflection and misalignment... high capacity always 100% available... complete freedom from adjustment, either in assembly or for wear.*

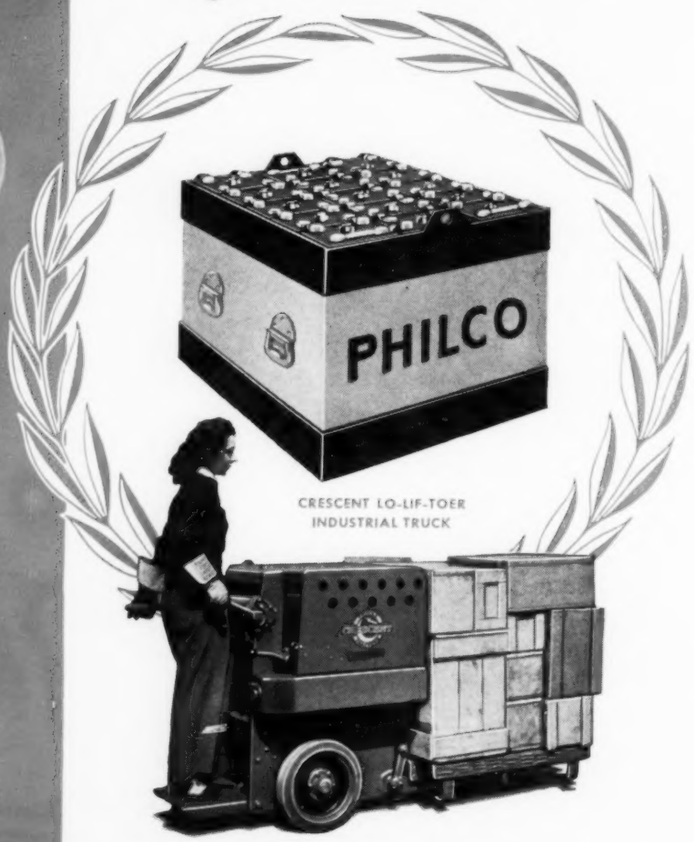
Get 10% more work out of your electric trucks with

PHILCO *Storage Batteries*









CRESCENT LO-LIF-TOER
INDUSTRIAL TRUCK

With Philco "XL" Batteries in your electric industrial trucks, every charge hauls 10% more material! Every cell provides 10% extra capacity without increase in overall battery dimensions!

The *extra work* you get from a Philco-powered truck is the reason materials handling men in war plants, embarkation ports and warehouses from coast to coast are replacing worn out batteries with rugged, heavy-duty Philco cells.

For the name of your local Philco representative, consult your classified telephone directory. Write for the Philco Industrial Truck Battery catalog.

Philco Corporation, Storage Battery Division, Trenton 7, N. J.

REPLACE WITH RUGGED PHILCO BATTERIES

ARMY E ★★★ NAVY

GENEVA COKE PLANT BEGINS OPERATION

▲ Coke production began December 14th in the by-products coke ovens at Geneva, Utah, according to officials of Geneva Steel Company, United States Steel subsidiary. This is the initial phase of operations at the $180,000,000 steel plant near Provo, designed to supply ship plates for the West Coast shipbuilding program.

It was in April, 1942, that the 1600-acre plant site was cleared of small farm buildings which dotted the area. Construction was undertaken at the request of Defense Plant Corporation by Columbia Steel Company, West Coast subsidiary of U. S. Steel. In August of this year, Geneva Steel Company, a newly formed U. S. Steel subsidiary, contracted with Defense Plant Corporation to operate this great war plant for the duration without profit or fee.

To supply coal for coking purposes, which in turn will supply coke and other fuels for the Geneva Steel plant, the Geneva mine in southeastern Utah was developed and is now shipping coal to Geneva's by-products coke plant.

Coke is made by heating crushed coal in the air-tight ovens from 17 to 19 hours at temperatures ranging up to 2,000 F. During the heating process the volatile constituents of the coal are driven off in the form of gases. These gases, though, don't "go up in smoke." They are reclaimed as by-products such as gas for fuel purposes, coal tar, ammonium sulphate, benzol and others. The residue, which is largely carbon, is the coke. It is removed from the ovens, cooled, graded according to size and is then ready for use in the blast furnace. There are four batteries of coke ovens at Geneva, 63 in each battery. One of these batteries is now in production.

ELECTRODE OFFERS LARGE SURFACE AREA

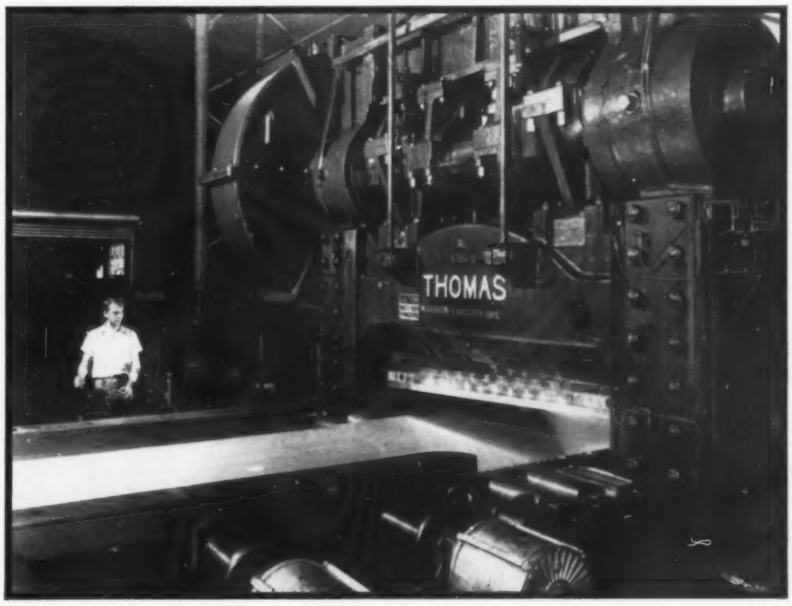
▲ A new type of lead anode for electroplating has been developed by the Heil Engineering Company, 12901 Elmwood Avenue, Cleveland. Known as a "sawtooth" anode, it differs from the standard flat anode in several ways.

The multi-angled surface gives 50 percent more area than a flat anode, resulting in greater electrical efficiency and throwing power, and the multiple edges increase the anode's effectiveness when used between two work rods.

One side has ten edges and the other side has a central spine a half inch thick running down the center.

SHEARS DESIGNED FOR ALUMINUM PLANTS

A worker at the electrical controls halts a plate of aluminum beneath a high speed shearing knife in one of the huge new fabricating plants of Aluminum Company of America. The rolls are conical so that the plate makes contact only along the edges to avoid scratching the highly polished surface. These 1½ inch shears were manufactured by Thomas Machine Manufacturing Company, Pittsburgh, Pennsylvania. Thomas shear installations in Alcoa plants include shears up to 3 inch capacity — among the most powerful plate shears ever used for this type of work.



This spine connects directly with the hook, insuring double the average anode life and providing greater current carrying capacity from top to bottom. The angular construction lends rigidity and offers resistance to buckling or warping.

These anodes are made of extruded lead, which has a denser structure than cast lead and offers more resistance to corrosion effects. Hooks are coated and integrally bonded to the anode to provide a continuous metal conductor. Five standard hook styles are available, designed for varying uses of anodes, and special hooks may be had on request.

The "sawtooth" anode is manufactured to sell in the same price range as standard flat anodes.

WEATHER MAP FOR TRANSFORMER OVERLOAD

▲ The Pennsylvania Transformer Company has prepared statistics on the very important subject of "How To Get More Load Out of a Transformer During the Four Winter Months."

Due to low ambient temperatures during the winter, transformers are capable of carrying more load than their nameplate reading.

The Pennsylvania Transformer Company has used U. S. Government Weather Bureau Reports in charting winter temperatures throughout the country. In turn, these temperatures were used to determine the amount of overload that transformers can carry in specific regions throughout the country.

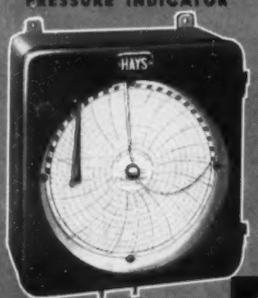
On the basis of this, a map was prepared and divided into five temperature zones with the overloads for these zones indicated.

Copies of this map and the information accompanying it may be obtained by writing to the Pennsylvania Transformer Company, 808 Ridge Avenue, Pittsburgh, 12, Pa., and asking for the Winter Overload Map.

A Real Aid to
PRODUCTION

TYPE CDE-X FURNACE PRESSURE CONTROLLER

SERIES FOT PRESSURE INDICATOR



SERIES OT PRESSURE RECORDER

HAYS
OPEN HEARTH PRESSURE CONTROL

TONNAGE can be increased through more even operation and even operation also means fuel saving. Automatic control of furnace pressure, rates of fuel and air flow, ratio of fuel to air, constant volume or pressure of oil or gas relieves the operators of many time-consuming details, allowing them to pay more attention to the steel making process.

When desired, the control of these various functions can be handled manually from a centralized panel through remote operation. Hays control is all-electric, simple to install, simple to operate, simple to understand.

The following Hays instruments may be used effectively in combination or separately for the functions indicated.

Type CDE-X Furnace Pressure Controller with external manual adjustment for automatically operating stack damper to hold pressure constant.

Series FOT Pressure Indicator provides an easily read measurement of furnace pressure. Usually connected at furnace roof.

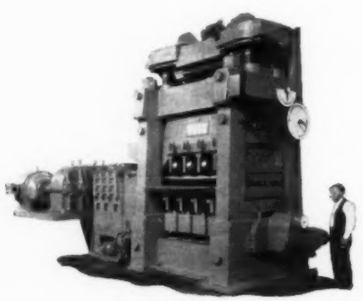
Series OT Pressure Recorder provides daily record (24 hr. chart) of furnace pressure. Shows timing of reversals and each change of pressure made by operator during the heat.

Hays partial or complete instrumentation is a REAL AID TO PRODUCTION. Hays representatives located in the principal cities of the U.S.A. and Canada will gladly supply complete information.

The HAYS CORPORATION
SINCE 1901 — COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

HEAVY ROLLER LEVELER FOR ARMOR PLATE

▲ An armor plate leveler, the largest and heaviest of its type ever built, has been completed by Voss Machinery Company of 2890 West Liberty Avenue, Pittsburgh, 16, Pa.



This heavy armor plate leveler possesses many recently patented developments.

Designed by the Voss engineering department, the new big leveler has all the features of the former machines, and includes recent Voss developments and patents.

This machine sets new standards and is regarded as the forerunner of many more heavy and powerful Voss levelers.

CENTRAL LABORATORY FOR ORE RESEARCH

▲ Plans for the establishment of a new iron ore research laboratory at Duluth, centralizing the research activities of Oliver Iron Mining Company, United States Steel Corporation subsidiary, were announced recently.

The new research facilities at Duluth will enable the Oliver Company to continue and intensify its pioneering program of research in the interest of general improvement of Lake Superior district iron ores used by steel-making subsidiaries of United States Steel Corporation. The company has been carrying on for many years a program designed to study ways and means of improving iron ores currently being mined, and to make experimental investigations of the concentration of lower grade iron ore formations for future use. In addition, United States Steel's research department has conducted a long-range program of experiments with a view toward conservation of natural resources through greater use of lower grade iron ore.

A four-story fireproof building in West Duluth has been purchased by the Oliver Company and will be remodeled to meet requirements for laboratory purposes.

METAL CLAD BREAKER LINE EXPANDED

▲ Large air circuit breakers in individual metal enclosures, for public utility and heavy industrial service, are announced by the I-T-E Circuit Breaker Co., Philadelphia, Pa. These breakers are the I-T-E type LG and are available in ratings from 2000 to 10,000 amperes, with interrupting ratings of 75,000 and 100,000 amperes. Standard voltage ratings are 600 volts a-c and 250 volts d-c. Operation may be either manual or electric.

The enclosures are built of heavy-gauge, bonderized sheet steel and can be supplied for either indoor or outdoor service. Either type gives full protection for the circuit breaker, which may be opened or closed without opening the enclosure. Large doors at front and rear provide access to the breaker and the connection studs. Connecting cables may enter the enclosure at the top, bottom or sides.

MORE PRODUCTION RECORDS AT J & L

▲ The continued drive for more war steel resulted in several more new high production records during November in the plants of the Jones & Laughlin Steel Corporation.

At the Pittsburgh Works the No. 6 blast furnace and the open hearth shop composed of furnaces Nos. 17, 18, 19 and 20 broke their best previous record of October 1942, while the No. 13 bar mill broke a record established in 1920, more than two decades ago.

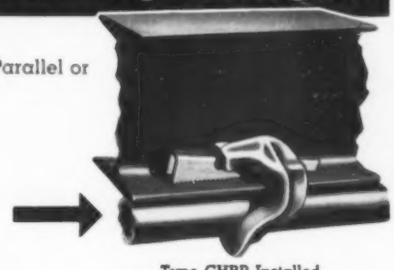
No. 3 seamless hot mill at the Aliquippa Works broke its April 1943 record and the sintering plant at the

CROUSE-HINDS

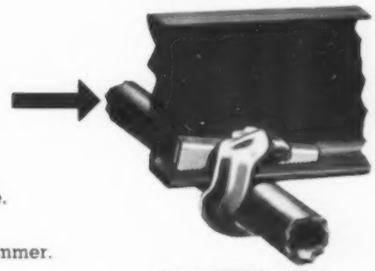
NEW Dual-Purpose

Type CHRP *Wedgtite* Pipe Hangers

● **Hangs pipe either way.** Parallel or at right angles to structural support.



Type CHRP Installed Pipe Parallel With I-beam



Type CHRP Installed Pipe at Right Angles to Channel Iron

● **Simple.** Only 2 parts, a hook and a wedge.

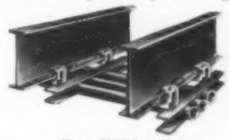
● **Easily installed.** A few blows of a hammer.

● **Malleable iron hook.**

● **Hardened steel saw-tooth wedge** bites into flange, making a tight, vibration-proof grip.

● **Adaptable.** Sizes for ½ to 2-inch pipe. Can be used on any I-beam, channel iron, or other structural shape having a flange ⅛ to 1⅛ inch thick.

Other *Wedgtite* Pipe Hangers.



Type CHU Installed Pipe Suspended from a Structural Support

Type CHB for Pipes Parallel or at Any Angle with Structural Support

***Wedgtite* pipe hangers can be used for electrical conduit, water pipes, steam pipes and sprinkler systems.**

A Nationwide Distribution Through Electrical Wholesalers

Wedgtite Hangers are listed in Condulet Catalog No. 2500, Section 70, Pages 3 and 4. Type CHRP Wedgtite Hangers replace both type CHR and type CHP.

CROUSE-HINDS COMPANY

SYRACUSE, N. Y., U.S.A.

Offices: Birmingham — Boston — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York — Philadelphia — Pittsburgh — San Francisco — Seattle — St. Louis — Washington

Resident Product Engineers: Albany — Atlanta — Charlotte — New Orleans

CROUSE HINDS COMPANY OF CANADA, LTD. *Main Office and Plant:* TORONTO, ONT.

Otis Works, Cleveland, broke its record of September 1943.

The blast furnaces at Pittsburgh Works made a new production record for a thirty-day month and a similar record was also established by the Pittsburgh Works rolling mills.

Also, all previous records for a thirty-day month at Pittsburgh Works were broken in November when they made a new record for shipments of steel products.

LAKE ORE FLEET "COMES THROUGH"

PURDY PIX

As the ore season draws to a close early in December, ample ore has been brought down the lakes to insure full operation of blast furnaces. Shown here is the B. F. Affbeck, one of the 76 ore carriers operated by U. S. Steel's Pittsburgh Steamship Company, as the vessel was unloaded at the Conneaut dock of the Pittsburgh and Conneaut Dock Company, another U. S. Steel subsidiary. A third subsidiary, the Bessemer and Lake Erie Railroad Company, transports the ore from Conneaut to the Pittsburgh district.

HACK SAW CUTS LARGE SECTIONS

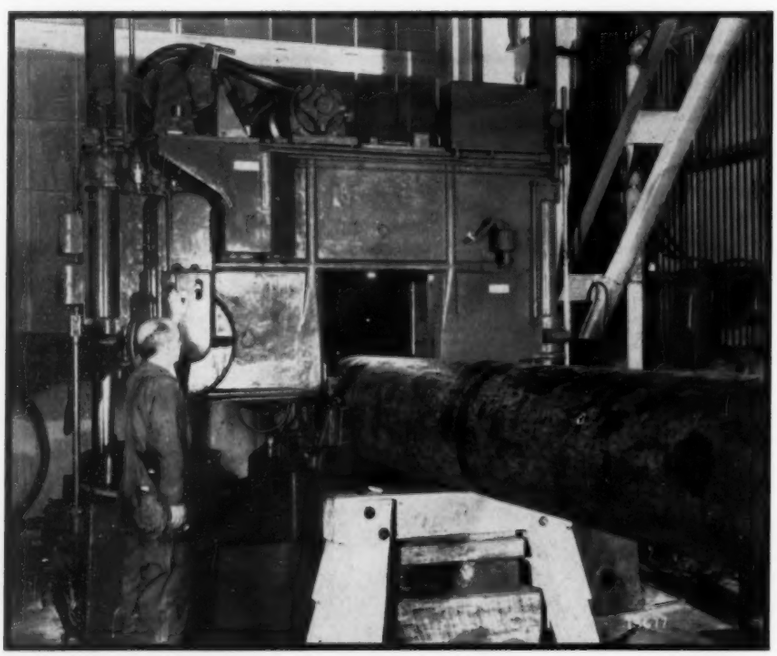
▲ Made by the Armstrong-Blum Manufacturing Company, Chicago, Illinois, the new No. 24 Marvel universal hydraulic roll-stroke hack saw shown in the accompanying illustration is installed in the plant of Mesta Machine Company. It is the largest capacity hack saw built, having a capacity of 24 in. x 24 in. The machine weighs 16,000 lb, is 151 in. high and covers a floor space 56 in. x 122 in.

Representing the latest developments in hack saw machines, the unit was developed to meet the need for a saw to cut off or trim large billets, blocks and forgings fast and accurately, retaining the advantages of low initial cost, low tool cost, small chip loss, low power consumption, low maintenance and simplicity of operation common to hack sawing methods.

The design is similar to smaller units previously manufactured, employing the same low pressure feed and unique roll-stroke cutting action. All moving and essential machine parts are fully enclosed and protected against abrasive dust and dirt. The special saw blade, of composite type with high speed steel teeth and a tough alloy body, is 36 in. long, 4½ in. wide and ⅛ in. thick, with 2½ teeth per inch.

Reports from the first installation indicate that this saw has solved the problem of cutting large pieces fast, accurately and economically.

Fast, accurate, economical cutting of large billets, blocks and forgings is offered by this hack saw, said to be the largest hack saw ever built.



VARNISH REQUIRES NO CRITICAL MATERIAL

▲ The Watson-Standard Company, of Pittsburgh, Pennsylvania, has announced the development of a new insulating varnish. Although formulated without the use of critical materials, the new product, according to the company's announcement, is in every respect the equal of pre-war varnishes.

A highly technical specialty, insulating varnish must have many important properties, since a thin film must do so much. Insulating varnish must have heat endurance. It must be resistant to fresh water, sea water, acids, and alkali, and must have high dielectric strength.

Varnishes made with Chinawood oil and phenolic resins have done this job for many years. But with the

supply of these materials restricted by the necessities of war, every effort has been made to develop an insulating varnish made of other materials. The new Watson-Standard product designated by the manufacturer as "V-2315", makes use of available materials without sacrifice of any of the requirements of insulating varnish.

New Literature

▲ "Lighting Handbook," published by the Lamp Division of Westinghouse Electric and Manufacturing Company, Bloomfield, New Jersey, is a practical guide to lighting design and a quick reference on illumination. It is not a complete treatise on the subject. Emphasis is placed on the practical aspects of the subject rather than on the artistic or technical. Effort is made to present tables and formulae, where possible, in a simplified form so as to permit rapid yet accurate illumination design.

▲ Surface Combustion, Toledo, Ohio, has just issued an attractive booklet entitled "The Heat Treating Furnace." Giving a brief outline of the factors — tangible and intangible — which contribute to producing a good industrial furnace, the booklet is intended to give some industrial furnace background to new users of this type of equipment, and to point out new developments to those who face conversion of war production lines to products for peace.

▲ National Carbon Company, Incorporated has just issued a new bulletin, Catalog Section M-8000, covering the industrial applications of "National" and "Karbate" carbon and graphite products. This bulletin contains 16 pages, well-illustrated. It may be had by writing directly to the National Carbon Company, Carbon Products Division, P. O. Box 6087, Cleveland 1, Ohio.

▲ A new illustrated engineering manual (SS-44) on Rex-flex stainless steel flexible tubing and bellows has just been issued by Chicago Metal Hose Corporation of Maywood, Illinois. This manual contains much engineering data and specifications not heretofore published. Characteristics of the product are shown in detail, with tables of sizes, weights, wall thicknesses of the various wall forms, together with pressure data, minimum bending radii and a wealth of other detail useful to the engineer. Complete data on fittings is also given, with diagrams and instructions for attaching fittings, and recommended design procedure for various types of applications. One feature of special interest is the double page spread giving, in chart form, line-loss data on Rex-flex tubing and elbows. There are many detailed photographs and illustrations of new interest to design, production and maintenance engineers in the 36 pages of this new two-color book. Published by Chicago Metal Hose Corporation, Maywood, Illinois.

▲ Published by Norton Company, Worcester, Massachusetts, the booklet, "The A-B-C of Internal Grinding" (64 pages), is intended primarily for operators of internal grinding machines. It endeavors to answer some of the practical questions such as how to select the proper wheel for different internal grinding jobs and how to correct common grinding faults.

▲ A new continuous draw bench, the United Unidraw, is described in an illustrated booklet just put out

ATMOSPHERE
FURNACES
MUFFLE TYPE
These furnaces are designed for the heat treatment of all types of steel in a protective atmosphere. They utilize the refined products of gas combustion as a protection atmosphere to minimize scaling and decarburization.
A VERY MERRY CHRISTMAS FROM
TATE-JONES
& CO. INC. · LEETSDALE (Pittsburgh District) PA.
Rotating Hearth, Car Bottom, Pusher, Conveyor, Roll Down, Horizontal and Vertical Pit, Circular and Rectangular Pot Furnaces. Also Gas, Oil and Combination Burners

by United Engineering and Foundry Company, Pittsburgh, Pennsylvania. A 4-hole bench with alternating carriages each pulling two work pieces, the machine requires only one operator, while having a productive capacity five times that of the ordinary bench.

▲ The Watson-Stillman Company, of Roselle, New Jersey, has just issued Bulletin No. 320-A covering its line of straightening and bending presses. This is probably the most complete coverage of this type of hydraulic machinery. Thirty-eight pages of descriptive matter, illustrations and tables of work capacities, are augmented by engineering tables and other technical data.

Ten of the standard Watson-Stillman presses are treated individually in separate chapters. A separate section covers miscellaneous straightening and bending presses.

Each different machine is fully described and illustrated, indicating its versatility in many kinds of straightening and bending operations. If you would like a copy of this valuable booklet, write your request on your business letterhead.

▲ Based on award papers in the 1940-42 Industrial Progress Award Program, "Maintenance Arc Welding" has been published by the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio. Twenty-five of the most significant award papers in the maintenance classification form the volume, which deals with the use of arc welding in reclaiming broken and worn parts and gives details on the application of welding in the fabrication of replacements. The information will be found useful in keeping machinery and plants in operation despite critical shortages in materials and equipment.

▲ A new catalog section on its line of Flexite rubber pouring buckets, for the safe and economical handling of acids, corrosives, and liquid high explosives has just been issued by The B. F. Goodrich Company and is available upon request. The publication also describes Flexite rubber dippers, hard rubber funnels, and rubber gloves.

Among products described is a comparatively recent addition to the line, a rubber bucket developed especially for arsenals and shell loading plants. Made in a soft rubber compound of about 60 durometer hardness, the bucket is so flexible it can be easily crushed and any solidified liquid cracked loose and readily removed.

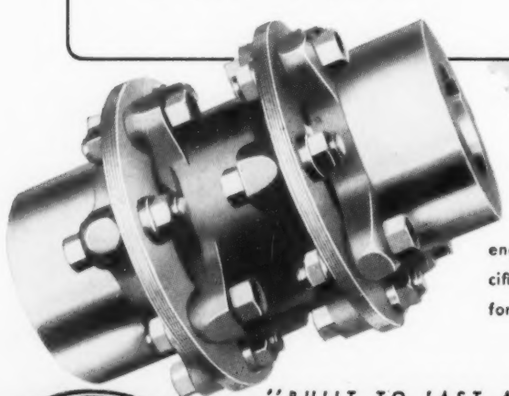
Rubber buckets and dippers are used in plants manufacturing storage batteries, heavy chemicals, fire extinguishers, rayon, paper, sulphite pulp, plate glass and nitro-cellulose products, steel mills, chemical laboratories, ore reduction plants and smelters, cider mills and fruit washing plants, tanneries, laundries, bleacheries and dye houses, electroplating, water softening and sewage disposal plants.

▲ "Maintenance and Care of Clamshell Buckets" is the title of a twenty-page booklet in color just released by the Blaw-Knox Division of Blaw-Knox Company, Pittsburgh, Pennsylvania. Now that it is difficult to buy new buckets, the maintenance problem is of first importance, and this booklet, liberally illustrated with photographs and diagrams of parts and assemblies, should prove especially timely to the trade.

THOMAS
FLEXIBLE
COUPLINGS

NO BACKLASH · NO WEAR · NO THRUST
NO LUBRICATION · FREE END FLOAT

These are the five essential features for a permanent care-free installation not found in any other make or type of flexible coupling. THOMAS Flexible Couplings save millions of dollars in maintenance every year and provide longer life for your equipment.



Write for the new "Thomas Catalog". It contains complete engineering data and specifications on couplings for all standard purposes.

"BUILT TO LAST A LIFETIME"

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA

C-4

SERVICE RECORDS PROVE
ROCKBESTOS A.V.C.
Gives Long-Lived Performance
In "Hot-Spot" Locations
The Rockbestos Construction that provides long wire life.*
Rockbestos A.V.C. Power Cable above and similarly insulated Motor Lead Cable (Underwriters' and Nat. Elec. Code, Type AVA) has a maximum operating temperature rating of 110° C. (230° F.) and this permanently insulated construction:—
1. The conductor is perfectly and permanently centered in helically applied insulation.
2. Impregnated felted asbestos insulation withstands conductor-heating overloads and won't burn even when exposed to copper-melting arcs.
3. Lubricated varnished cambric for high dielectric strength and added moisture resistance, protected from heat and flame between two felted asbestos walls.
4. Outer felted asbestos wall impregnated with heat, flame and moisture resistant compounds serves as a heat-barrier against high ambient temperatures.
5. A tough, rugged asbestos braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.
* One of 122 different wires and cables developed for severe operating conditions by Rockbestos.
WON'T bake brittle, bloom, burn or rot—RESIST moisture, oil, grease and fumes.
1
2
3
4
5

Every mail brings in numerous service reports from our field engineers carrying proof that Rockbestos A.V.C. gives long-lived performance in electrical circuits that run around furnaces, soaking pits, lehrs, kilns, hot strip mills, boilers and other "hot-spot" locations. Service comparisons show that where the insulation on other wires breaks down because of conductor-heating overloads, high ambient temperatures and moisture, and other severe operating conditions, *permanently insulated* Rockbestos A.V.C. gives dependable performance year in and year out.

Designed especially for high temperature applications and severe operating conditions, Rockbestos A.V.C. resists heat and moisture, oil, grease, and corrosive fumes. Its *permanent insulation* won't bake brittle, crack, bloom, rot, flow or swell. Stop periodic wire failures in your plant; use Rockbestos A.V.C.

When inquiring or ordering, please furnish CMP allotment number and certification. For complete information and samples, write nearest branch office or:

Rockbestos Products Corporation, 921 Nicoll St., New Haven 4, Conn.

ROCKBESTOS A.V.C.

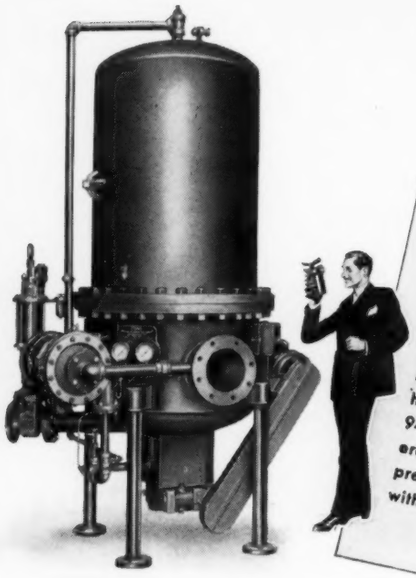
The Wire with Permanent Insulation

FOR VICTORY—INVEST IN U. S. WAR BONDS

NEW YORK, BUFFALO, CLEVELAND, CHICAGO, PITTSBURGH, ST. LOUIS, LOS ANGELES, SAN FRANCISCO, SEATTLE, PORTLAND, ORE.

CUNO

FREES FLOW-LINES FROM 2 TYPES OF SHUTDOWN . . . WITH EITHER OF TWO TYPES OF FILTERS

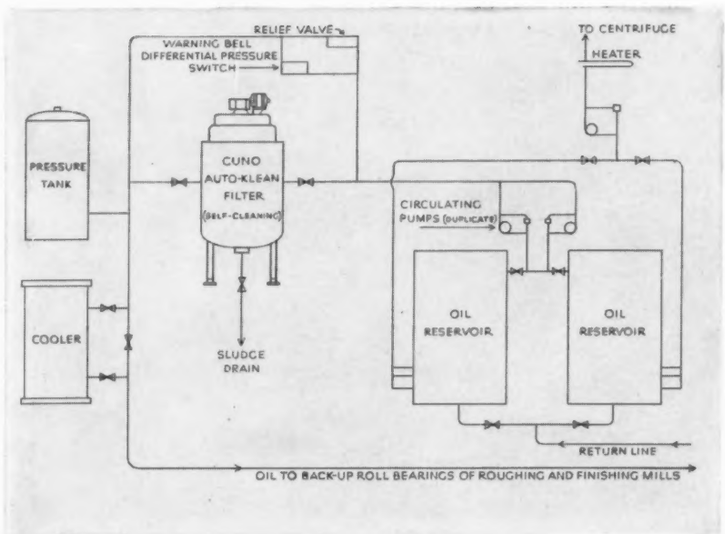


The flow diagrams show two typical installations: at the right center, Cuno Auto-Klean handling full flow of oil to roll neck bearings — 2300 SSU at 100°F, 650 GPM; at the right below, Cuno Flo-Klean handling roll body coolant, 94% water, 6% soluble mineral oil, 347 GPM with 4-lb. pressure drop or 231 GPM with 3-lb. pressure drop.

Shutdowns caused by faulty or inadequate fluid-cleaning. Cuno "filter-fine" straining — based on the principle of edge filtration — provides positive protection against damage caused by abrasive particles in the fluid. No particles larger than specified can pass through a Cuno filter.

Shutdowns necessitated by filter-cleaning. Cuno Auto-Klean (disc-type) and Flo-Klean (wire-wound) Filters are cleanable while in operation handling full flow. Thus you get continuous production without the expense of a duplex installation. The Auto-Klean cleans itself when a handle is turned; the Flo-Klean is cleaned by a momentary reversal of flow.

Cuno filters are used today on the great majority of continuous hot and cold strip mills in this and other countries . . . also on many other types of mills.

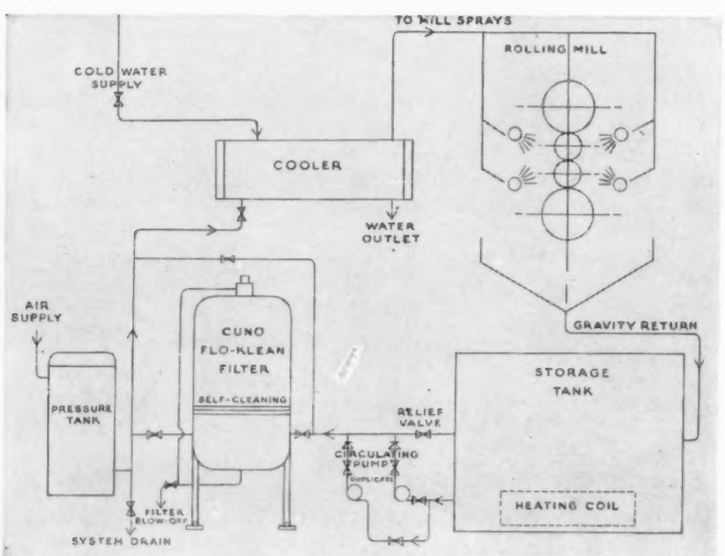


NEW BOOKLET EXPLAINS OTHER USES—

Cuno Auto-Klean: for lubricating and fuel oil as well as other industrial liquids.

Cuno Flo-Klean: for fluids of high abrasive content: descaling spray and roll body coolant.

Write for free booklet "Quick Facts". Cuno Engineering Corp., 912 South Vine Street, Meriden, Connecticut.

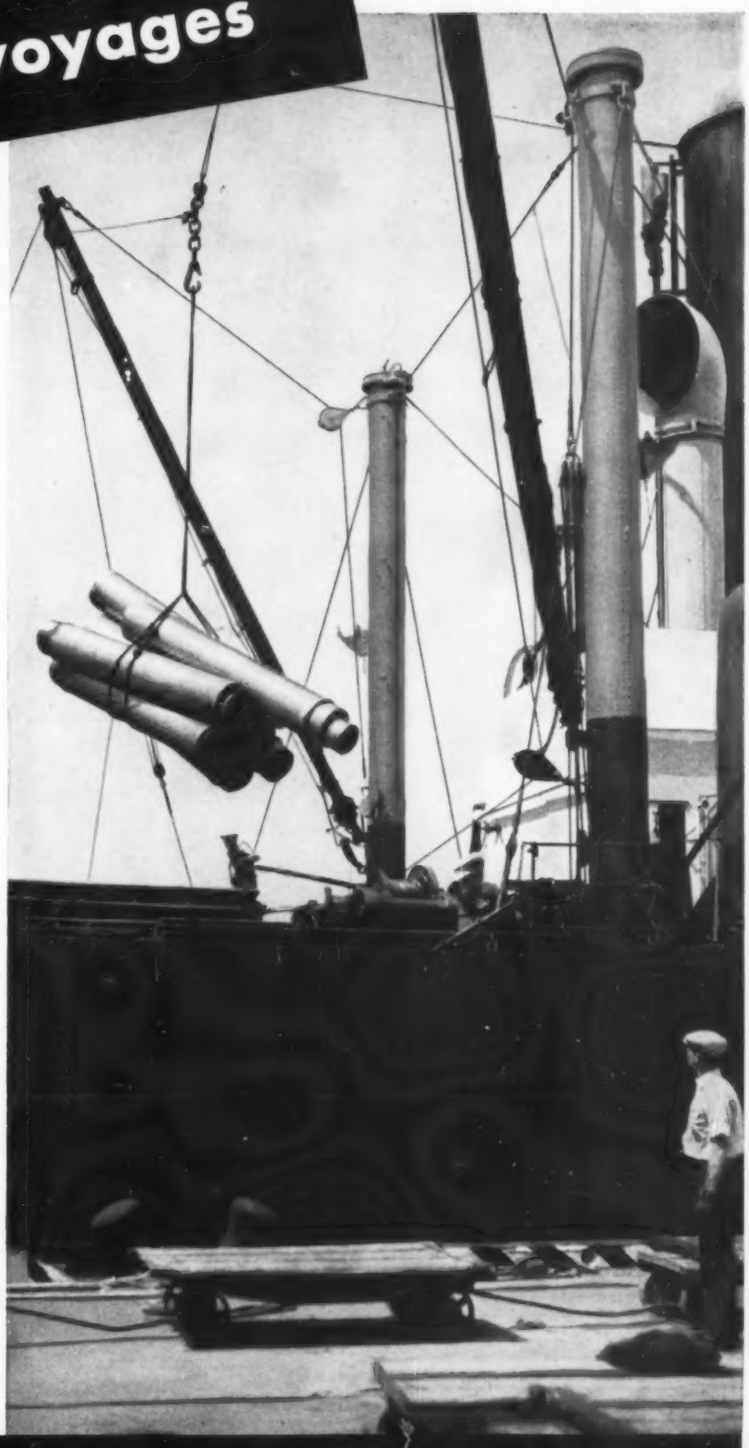


KEEP FLOW ON "GO" WITH

CUNO

NO STOPS FOR CLEANING FLUID . . .
NO STOPS FOR CLEANING FILTER

To protect STEEL for its ocean voyages



Rust is today, as always, the enemy of steel. Just as finished parts are carefully protected, so must raw steel—bars, strip and sheet, coils, tubes, plate, wire and tool steel—be armored against the ravages of rust.

The American Iron & Steel Institute, realizing that this is particularly vital for steel destined to be shipped over the seven seas under Lend-Lease, has compiled definite data for mills and warehouses.

Its specifications are met by Houghton Rust Preventives developed from a long line of worthy predecessors dating back to 1867. The Houghton man is equipped to discuss this important subject with any mill man whose duty it is to see that vital steel arrives at its overseas destination unharmed by corrosion.

Products for this purpose include dry types, fluid types leaving films less than .0003" thick, water-displacement types and heavy coatings and greases.

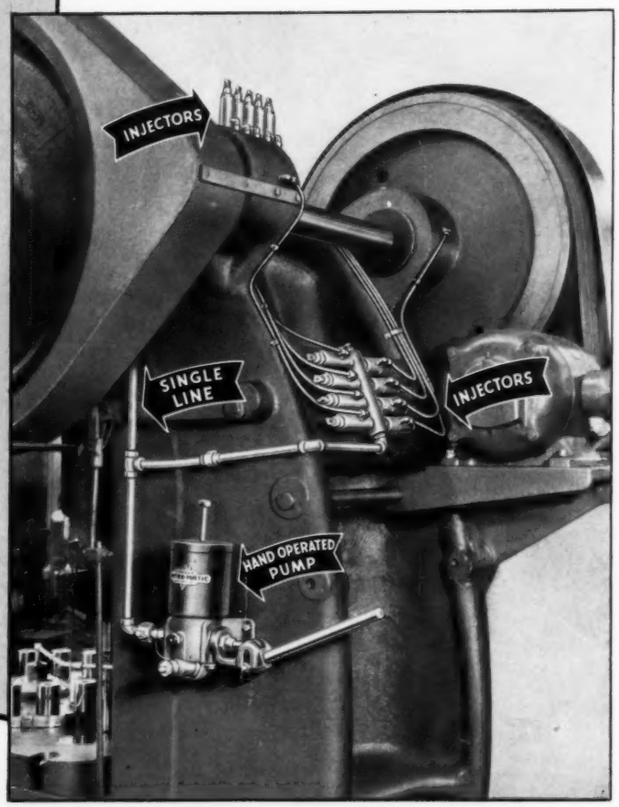
Ask for full details, specifying type of metal parts to be protected.

E. F. HOUGHTON & CO.
PHILADELPHIA
CHICAGO • SAN FRANCISCO • DETROIT

Houghton's **RUST** *Preventives*

LINCOLN
CENTRO-MATIC LUBRICATING SYSTEMS

cut down on bearing failures --and prevent delays in war production



These modern centralized lubricating systems are easily installed on new or old machines

Lubricate *all* bearings from a central source . . . Reduce the threat of bearing failures . . . Save man-hours . . . It's possible with Centro-Matic Systems.

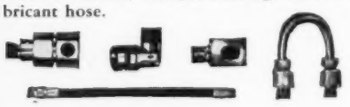
Under the Lincoln method you are sure that each bearing will get the proper amount of grease, and that no bearings will be overlooked. Service is performed quickly and economically—without stopping machines.

A Centro-Matic System consists of a number of Centro-Matic Injectors—one for each bearing—and a power operated or a hand operated Centro-Matic Lubricant Pump. A power operated system can be push button or time clock control...Only a single lubricant supply line is required...Easily installed on new or old machines. (Illustration above shows manually operated Lincoln Centro-Matic Lubricating System installed on a punch press).

Lincoln Model 1774 Air motor operated, 400-lb. drum pump. Pumps lubricant direct from original refinery container and is full automatic with time clock control.

Lincoln Centro-Matic injectors can be used either in manifold groupings or as single units depending upon the requirement.

Lincoln grease line accessories—high-pressure fittings and adapters, connectors, connector tube assemblies, fittings, bushings and lubricant hose.



Lincoln Model 1805. Manually operated Centro-Matic Pump, 2-lb. capacity

Model 81625 hand operated Filler Pump provides a quick, clean, easy and economical method of filling Centro-Matic Stationary Lubricant pumps.

The ARMY-NAVY PRODUCTION AWARD for high achievement in the production of war equipment, conferred upon the Lincoln Engineering Company has had a star added. This star symbolizes 6 more months of exacting service to our Armed Forces, delivering vital materials so necessary for ultimate Victory.

Write us today for complete information 143-47

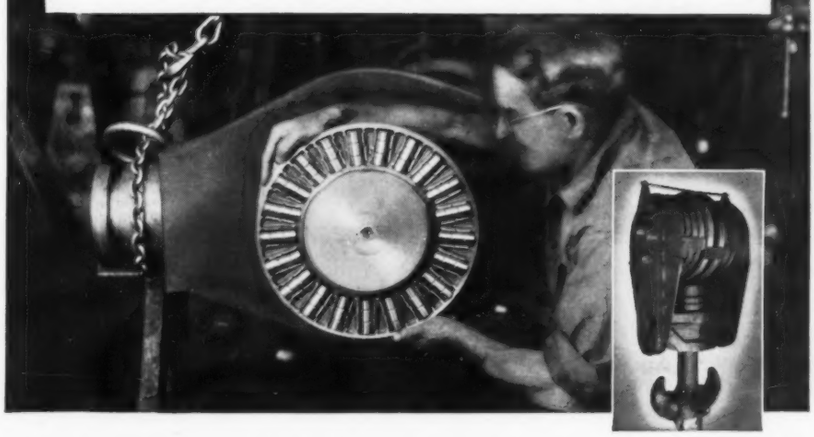
FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

LINCOLN ENGINEERING COMPANY

Pioneer Builders of Engineered Lubricating Equipment

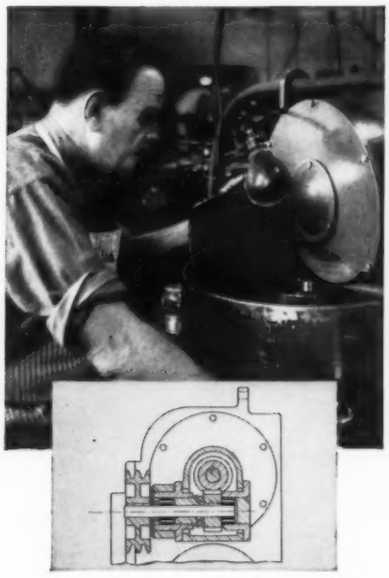
5701 NATURAL BRIDGE AVENUE, ST. LOUIS 20, MO., U. S. A.

IN THE NEWS
WITH TORRINGTON—BANTAM

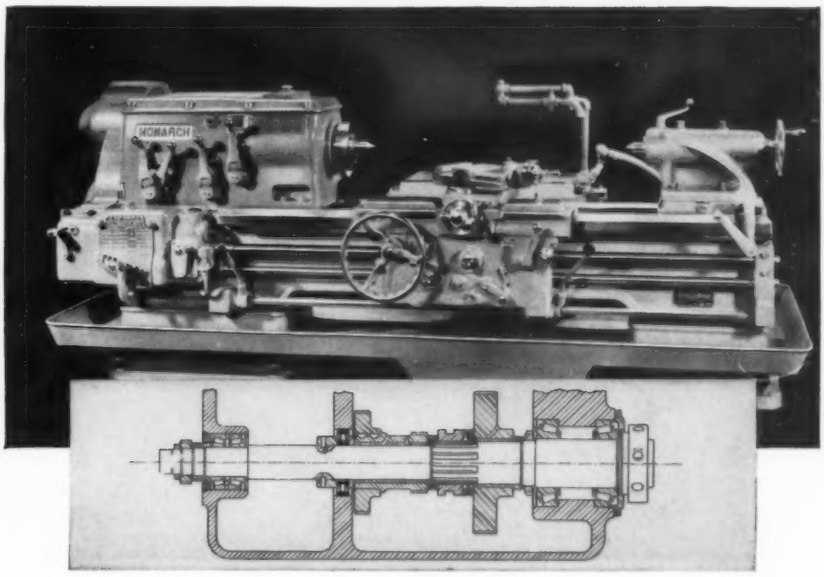


A LARGE PRECISELY CONSTRUCTED ROLLER THRUST BEARING, measuring over a foot in diameter, enables the giant 5½-ton hook, shown in the inset, to rotate smoothly and safely, even when encumbered by its 150-ton capacity load. When the Shepard Niles Crane and Hoist Corporation custom-designed this load block, which is to hang from an overhead electric traveling crane in a West Coast shipyard, they selected a Type LR-71 Roller Thrust Bearing for the yoke bearing because of its compact design which provides a static capacity of 155 tons. This is an excellent example of Torrington's ability to design and build bearings for unusual applications.

FILING SAW TEETH on hand, band and circular saws for the Army Air Corps is the destiny of these Automatic Saw Filers built by the Foley Manufacturing Company. The precise action needed to obtain accurate file cuts depends to a large extent upon the use of compact, high capacity NCS Needle Bearings.



GRINDING OF GEARS, WASHERS and rolls is done rapidly and accurately with this Rotary Surface Grinder made by the Arter Grinding Machine Company. In the four-speed change gear mechanism for the drive to the magnetic chuck, the makers have specified Type NCS Bearings with their compact design and high load capacity. Bearing application is shown in the accompanying cross-section.



NEW STANDARDS OF ACCURACY and performance in metal turning have been developed through the generous use of anti-friction bearings in this Model "M" 16-Speed Engine Lathe built by The Monarch Machine Tool Company. Giving high capacity in a minimum of space, Torrington Radial Roller Bearings have been used as the center support of the spindles of these lathes, as shown graphically in the accompanying cross-section.

BECAUSE OF THEIR LIGHT WEIGHT, low coefficient of friction and high lubricant capacity Needle Bearings serve a wide variety of special applications. If you have a seemingly difficult bearing problem, it may be solved quickly and easily by reference to Torrington-Bantam's complete line of Needle Bearings of all types and sizes. Whatever your bearing problem, TURN TO TORRINGTON for expert engineering counsel.

ARMY E NAVY
TORRINGTON BEARINGS
STRAIGHT ROLLER · TAPERED ROLLER · NEEDLE · BALL
THE TORRINGTON COMPANY · BANTAM BEARINGS DIVISION
SOUTH BEND 21, INDIANA

A STRONG FAMILY—

AND THIS MOVING FINGER MECHANISM FITS THEM ALL

These "3C" Bulletin 101 Master Switches are built to stand active service in heavy duty operation.

Roller Bearings on Type RD; Oilite Bearings on Types S2D and Types S4D; accurately molded Impact Bakelite Cams; sturdy steel shafts; Double Break Silver-to-Silver Contacts; and the same Moving Finger Mechanism is interchangeable in all types.

The Contact Bar is easily removed; Pressure Springs will not fly out, being held in place by a large end spring ring, which bears against the cage.

All these features and many more make for low-maintenance on these devices.

Write for fully descriptive "3C" Bulletin 101 Master Switches.

CONTINUE TO ROLL WITH CLARK CONTROL

THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, OHIO

Ol' Red Wabbler says:

"Nironite D Work Rolls in 4-high single stand and tandem cold mills *give better finish . . . save roll dollars*"

M-H Nironite D Work Rolls for 4-high single stand and tandem cold mills have attained their greatest success in replacing forged and hardened alloy steel rolls, because they have greater resistance to indentation. This means better surface finish for the cold rolled product and a reduction in cost, because M-H Nironite D Rolls stay in the stands longer between roll grinds. These rolls also have a greater hardness penetration and thus can be used down to scrap diameter without being rehardened.

You can get better surface finishes and save roll dollars at the same time. Specify M-H Nironite D Work Rolls for single and tandem cold mills.

Other Mackintosh-Hemphill Products:

Rolling Machinery . . . Shape Straighteners . . . Strip Coilers . . . Shears . . . Levellers . . . Pinions . . . Special Equipment . . . Iron-Steel Castings . . . The NEW Abramsen Straightener . . . Improved Johnston Patented Corrugated Cinder Pots and Supports.

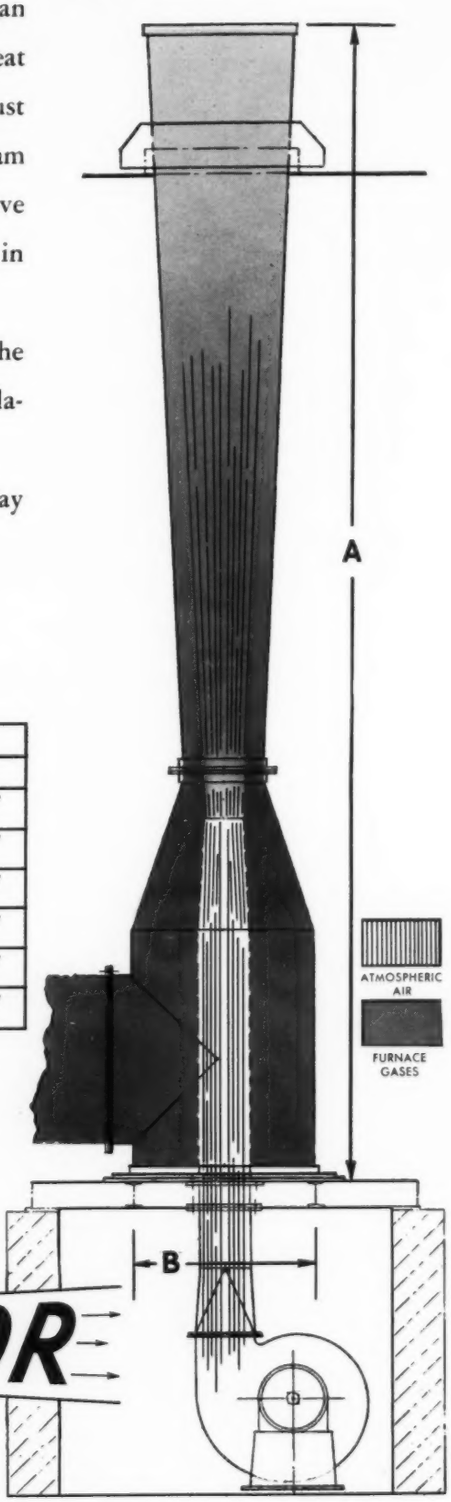
MACKINTOSH-HEMPHILL COMPANY • Pittsburgh and Midland, Pa.

Exhaust unaffected by WEATHER

You are your own "weather man" when you have the Morgan Air*jector* on the job. Cold winter winds or sweltering summer heat cannot affect the exhaust of your furnace because you set the exhaust precisely to suit your melting conditions. The fan-induced stream of air through the venturi throat and short stack sets up a positive suction that draws out the products of combustion, cools them in the short stack and discharges them into atmosphere.

A Morgan Air*jector* provides twice the draft available in the usual "tall stack" systems; requires less steel and smaller foundations—and far less maintenance.

Hundreds of Morgan Air*jectors* in use throughout industry today are increasing production and saving costs.



AIRJECTOR SIZES

(Draft at Airjector Base "@" W.G. 1)

SIZE	GALLONS OIL PER HR.	TEMP. OF EXHAUST GAS	FAN MOTOR H.P.	DIMENSIONS	
				A	B
No. 1	50	1000°F	7½	20′-6″	3′-8″
2	75	1000°F	10	23′-8″	4′-2″
3	100	1000°F	15	27′-9″	4′-9″
4	130	1000°F	20	31′-6″	5′-3″
5	175	1000°F	20	34′-11″	5′-8″
6	225	1000°F	25	38′-6″	6′-2″

AVAILABLE NOW in these and larger sizes. You can figure on prompt service in all cases where the moderate amount of steel will be made available. Consult our engineers.

MORGAN

AIR JECTOR

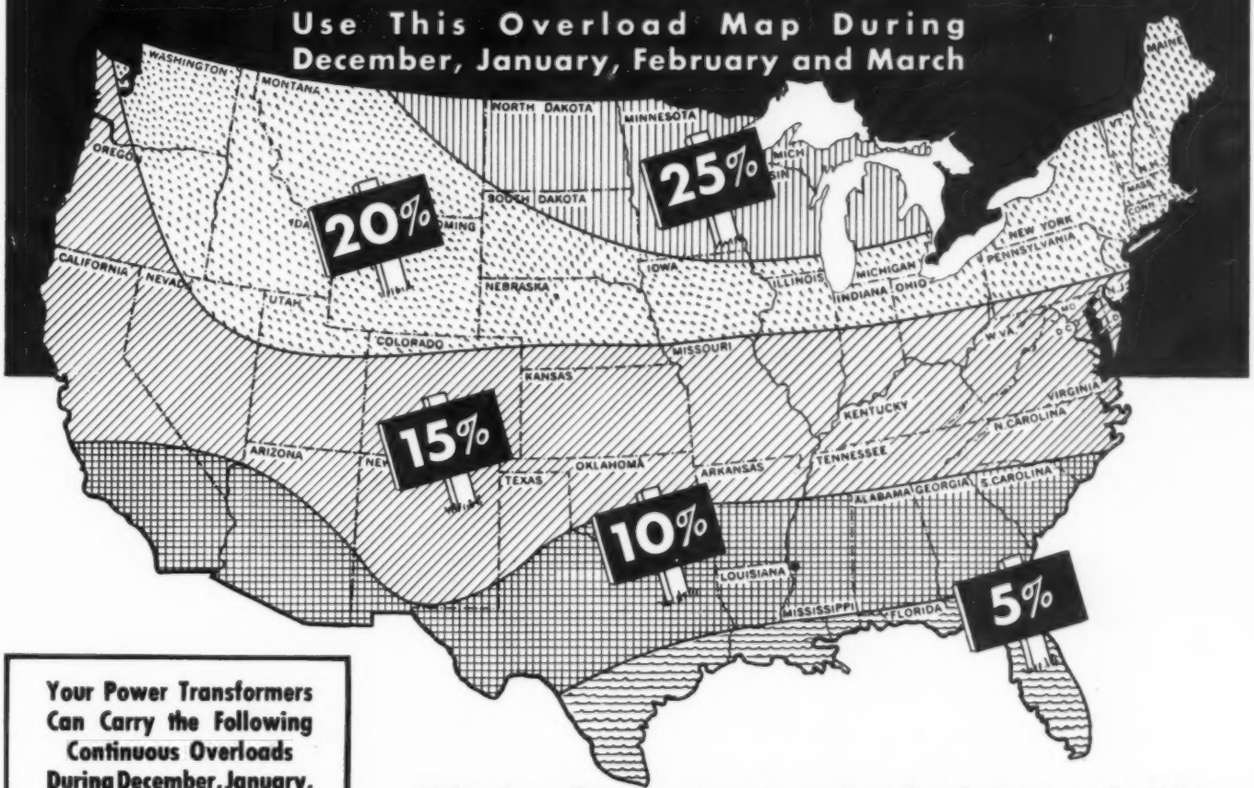
Ask Your Furnace Manufacturer to Investigate—We Assure Him Fullest Cooperation

V-41

MORGAN CONSTRUCTION CO. • WORCESTER, MASS.

GET MORE LOAD OUT OF YOUR TRANSFORMERS DURING THE WINTER

Use This Overload Map During December, January, February and March



Your Power Transformers Can Carry the Following Continuous Overloads During December, January, February and March	
Temperature Zone	Permissible Continuous Overloads
	25%
	20%
	15%
	10%
	5%

The above data applies to all Pennsylvania Oil and Askarel self-cooled transformers—55° C Rise.

For Transformers with Forced Air Cooling

Apply ¾ of the above percentages to the forced-air cooled rating.

Why Transformers Can Carry Overloads During the Winter

● Due to low ambient temperatures during the winter, transformers can carry more load than their nameplate rating. The transformer standards of the American Standards Association recommend that the continuous KVA loading for oil-immersed, self-cooled transformers may be increased one per cent for each degree that the daily average temperature is below 30° Centigrade.

Based on records of the U. S. Weather Bureau over a period of years, equivalent ambient temperatures were calculated for the 4 month winter period for representative locations throughout the country.

The equivalent ambient is the temperature which, if maintained constantly, would result in the same aging as that occurring under the actual ambient temperatures throughout the period. The equivalent ambient temperatures were used to calculate the permissible continuous overload capability for various temperature zones.

The continuous overloads indicated by the map and table may be safely carried during the 4 winter months because the operation of a transformer at low temperatures results in a slower aging of insulation which compensates for faster aging of insulation during operation at higher temperatures.

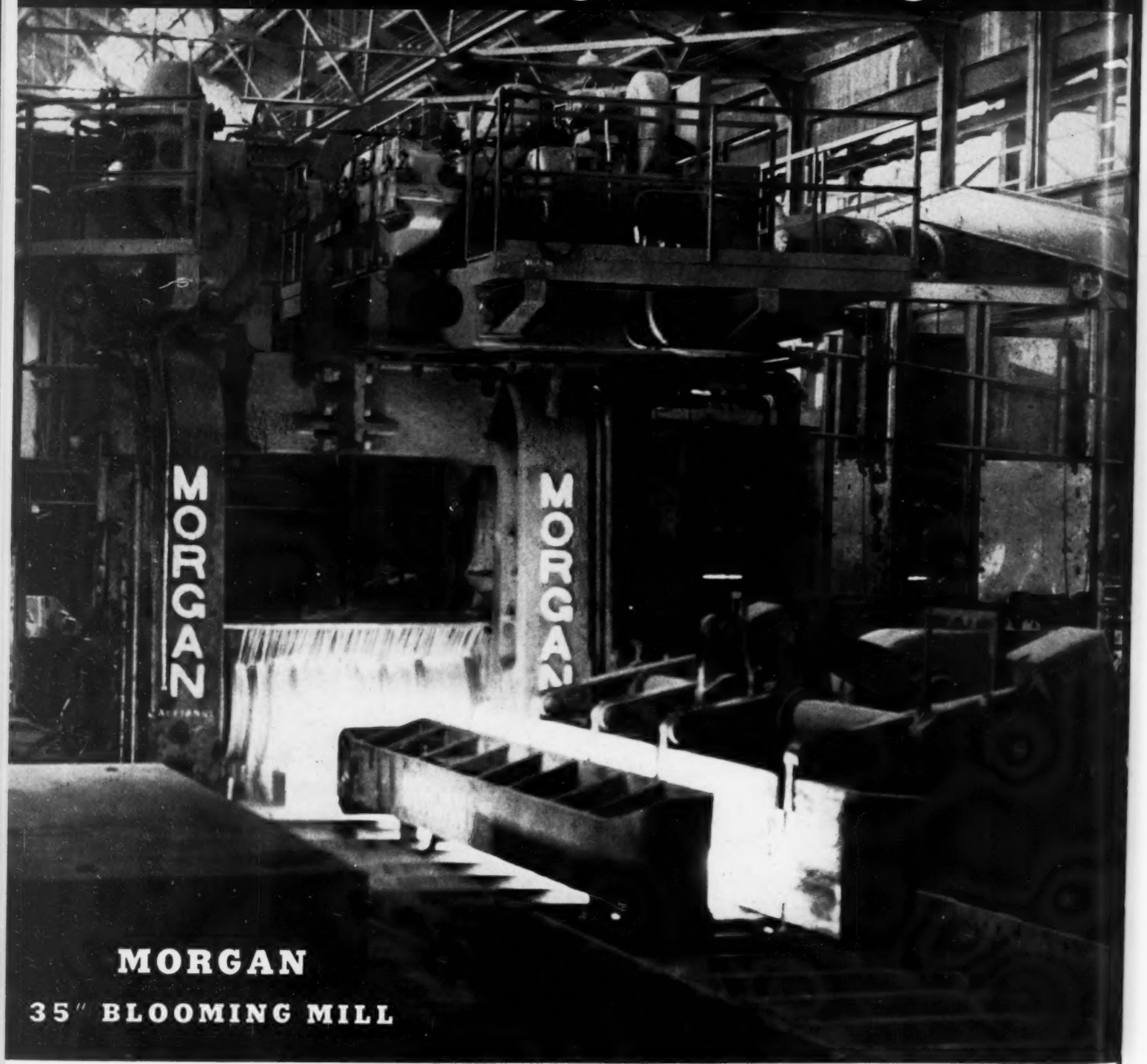
Pennsylvania TRANSFORMERS

Pennsylvania TRANSFORMER COMPANY

PITTSBURGH, PENNSYLVANIA

Reprints of This Page are Available Upon Request

BUILT BY MORGAN *Engineering*



MORGAN
35″ BLOOMING MILL

ABOVE is shown a Morgan 35″ two-high blooming mill complete with double manipulator, front and rear tables. A hydraulic roll changing device is provided. Housings are one-piece steel castings of the closed top type. Top roll balance is of the counterweight type. Manipulator is of the overhead type, compact and accessible. Tables are of heavy design, equipped with anti-friction bearings. Screw-down drive is arranged to provide crane hook access when changing guides. Provision is made for automatic lubrication and exclusion of scale and dirt.

★ **DESIGNERS • MANUFACTURERS • CONTRACTORS**
BLOOMING MILLS • PLATE MILLS • STRUCTURAL MILLS
★ ELECTRIC TRAVELING CRANES • CHARGING MACHINES
INGOT STRIPPING MACHINES • SOAKING PIT CRANES
★ ELECTRIC WELDED FABRICATION • LADLE CRANES
STEAM HAMMERS • STEAM HYDRAULIC FORGING
PRESSES • SPECIAL MACHINERY FOR STEEL MILLS
★

THE MORGAN ENGINEERING CO., Alliance, Ohio

★ Pittsburgh, 1420 Oliver Building

ITEMS OF INTEREST

Carnegie-Illinois Steel Corporation recently announced three appointments on the staff of the chief engineer in the Pittsburgh district of this U. S. Steel subsidiary.

J. W. Gwynne, formerly a staff engineer in the defense engineering department, was made engineer in charge of the defense engineering staff and government contracts. He has been with the company since 1919 when he was employed at Edgar Thomson Works and has been located in the city office since 1939.

L. B. Patin was appointed construction engineer in charge of Defense Plant Corporation contracts for the company. A member of the defense engineering staff since 1941 at the company's South Charleston, West Virginia plant, he was previously in charge of engineering and director of operations for the WPA in Ohio.

P. A. Granklin, a member of the company's engineering department since 1940, was appointed assistant construction engineer. Before coming to Carnegie-Illinois, he was employed as a structural engineer at Dravo Corporation, and had experience as a design engineer on the west coast before coming to Pittsburgh in 1922.

Thomas F. Scannell has been appointed general sales manager of The Falk Corporation, Milwaukee, Wisconsin. In his new capacity Mr. Scannell will be responsible for the sale of all Falk products, including steel castings. Prior to his new appointment, he was sales manager for all Falk products with the exception of those coming under the jurisdiction of the foundry division.

Mr. Scannell is a Yale alumnus, class of 1918. After a number of years with the Chain Belt Company of Milwaukee, he joined the Falk organization in 1928 and has been successively St. Louis representative and district manager of the southwest territory with headquarters in Dallas. In April, 1940, he was transferred to Milwaukee, being appointed sales manager for all except foundry products in June of 1941. He is active in the affairs of the American Gear Manufacturers Association and holds memberships in the American Petroleum Institute, the American Society of Naval Engineers, and the American Society of Naval Architects and Marine Engineers.

John S. Wilkinson, who has been connected with the Falk foundry in various capacities for many years, will function as assistant sales manager in charge of foundry sales.

M. M. Greer has been elected as vice-president in charge of engineering of Edwin L. Wiegand Company, Pittsburgh, Pennsylvania.

Mr. Greer joined the company in 1928, as an engineer in the experimental department, after graduating from Massachusetts Institute of Technology and serving two years as a metallurgist in the steel industry.

H. R. Miles succeeds Mr. Greer as manager of industrial sales.

Freeman H. Dyke, formerly superintendent of blooming, bar and hot strip mills, Wheeling Steel Corporation, Steubenville, Ohio, has been named assistant general manager of steel plant, mills and service department. Simultaneously, **John W. Unroe** was made assistant general manager in charge of by-product coke and blast furnace departments. Other personnel changes announced include **John P. Quinn,** superintendent of hot and cold rolling; **Richard A. Swift,** superintendent of by-product coke works;

FREEMAN H. DYKE

Richard C. Schaefer, in charge of 45 in. slabbing and 66 in. hot strip mills; **George R. Runser,** in charge of cold rolling; **Henry Ford,** assistant to the electrical superintendent; **George Merrick,** assistant superintendent, electrical department; and **George Herbert,** foreman, line and maintenance, electrical department.

Julius A. Clauss has resigned from his duties as chief of the Plant Facilities Branch, War Production Board, to return to his former position of chief engineer, Great Lakes Steel Corporation, Ecorse, Michigan.

W. T. Brown, formerly manager of coal, coke and by-product research for Jones and Laughlin Steel Corporation, has opened offices in the Grant Building, Pittsburgh, Pennsylvania, as a consultant on coal, coke and by-products.

R. G. Adair, assistant director of personal relations, of The American Rolling Mill Company, will serve on the staff of the industrial members of the War Labor Board, in Washington, D. C.

Mr. Adair, who has had broad experience in the industrial relations field, accepted this new post at the request of the War Labor Board's industrial members. Formerly assistant manager of Armco's Ashland division, he was recently appointed assistant director of personal relations for the entire company. After his work in Washington is completed he will assume that position and his headquarters will be located in the Armco general office, in Middletown, Ohio.

Joining Armco in 1916 as a laborer in the Middle-

NATIONAL ROLLS

THOUSANDS OF PRODUCTS DEPEND ON ROLLS

THE desire for excess tonnage from rolls should be tempered with the more patient ambition for uniformity and quality of output.

It is the quality of the output — and not how much was run in a given time — that builds prestige for the issuing mill.

In producing NATIONAL ROLLS, we look beyond the rolling mill to the thousands of uses to which plates and shapes are adapted after distribution. And in considering this field, uniformity of output, and not tonnage, is the more important factor.

Every NATIONAL ROLL is carefully manufactured, to the limit of our ability, not only to deliver the tonnage reasonably expected of it, but to produce a product that reflects credit on the issuing mill when passed on to the large army of users.

The NATIONAL ROLL & FOUNDRY CO.

All Grades of Plain and Iron Alloy Rolls—Both Chill and Grain Types
Heavy Iron Castings and Rolling Mill Equipment

AVONMORE, PA.

town plant, he became a foreman and then entered accident prevention work. After serving in World War I he returned to Armco as safety director. In 1930, Adair was appointed assistant to the manager of Armco's Butler, Pennsylvania, division and in 1939 became assistant manager at Ashland.

R. W. Piper long identified with the petroleum industry, formerly with the Sun Oil Company of Philadelphia, has joined The Hodson Corporation, lubrication engineers and manufacturers, Chicago, Illinois, and will be associated with Charles E. Weinkauf, manager of the Pittsburgh area, as technical adviser to the industrial trade, located in the Union Trust Building, Pittsburgh, Pennsylvania.

Mr. Piper has had an extensive experience with manufacturing interests, both electrical and mechanical, and as a technical adviser. After graduating from electrical engineering, Mr. Piper began his career as a student engineer at Westinghouse Electric and Manufacturing Company. Later, he joined the Pittsburgh Transformer Company as southeastern manager and continued in this connection until the Pittsburgh Transformer Company merged with the Allis-Chalmers Manufacturing Company.

Mr. Piper then joined a petroleum company as sales engineer and for the past thirteen years has been special representative of the Sun Oil Company, industrial products department, Central Region, Pittsburgh, Pennsylvania. In this capacity, Mr. Piper has done considerable work with the steel and allied industries in the application of petroleum products.

Specialists for over a generation in

OIL IMMERSED MOTOR CONTROL

ROWAN CONTROL
THE ROWAN CONTROLLER CO., BALTIMORE, MD.

Benjamin Eggers succeeds **J. R. Comstock** as general superintendent of the Globe Iron Works, Jackson, Ohio. Mr. Comstock is now superintendent of blast furnace, Pittsburgh Coke and Iron Company, Pittsburgh, Pennsylvania, succeeding **J. H. Williams** who has accepted a position with American Steel and Wire Company, Duluth, Minnesota.

F. R. Fishback was elected chairman of the board of the Electric Controller and Manufacturing Company, Cleveland, Ohio. He has been president since 1925, and is a graduate of Rose Polytechnic Institute in the class of 1902. **R. G. Widdows** is the newly elected president. He has been with the company for over thirty-three years, and during that time has served as district manager of the New York office, sales manager from 1924 to 1939, and vice-president since 1925. **A. C. Dyer,** new vice-president, will continue as sales manager, which position he has held since 1939. A graduate of Carnegie Institute of Technology he has devoted many years to the application of electric control to steel mill drives. **N. R. Richardson** has been production manager since 1932 and will continue in this capacity in addition to assuming the duties as vice-president. A graduate of Yale University, he has been with the company since 1924.

Carnegie-Illinois Steel Corporation announced recently two appointments in the metallurgical division, Pittsburgh district.

SLUDGE

Needs no introduction

Every fuel oil user is familiar with the evil effects of sludge in the oil system — clogged lines, preheaters, strainers, burners — poor combustion — loss of oil — loss of production.

DACAROL fuel oil treatment dissolves existing deposits and prevents future deposits in oil systems. Need we say more?

TRY IT IN YOUR OWN PLANT —
THEN JUDGE FOR YOURSELF

DACAR PRODUCTS

DACAR CHEMICAL PRODUCTS COMPANY

Wabash and McCartney Streets Pittsburgh, Pa.

SEE WHAT A NEW CRANE OFFERS . . .

Get this catalogue

Every time - and effort-saving advantage that can be built into a locomotive crane is a feature of this modern, late - design AMERICAN LOCOMOTIVE CRANE. A 60-page catalog describes these advantages and illustrates, by actual installation photographs, the wide variety of material handling jobs for which this late-design locomotive crane is a natural.

Whether for furthering the war effort or for postwar planning, you should write for a copy.

Ask for catalog 600-L-1A

60 Years of Safety 1883 - 1943 The Genuine CROSBY CLIP

AMERICAN HOIST & DERRICK CO
SAINT PAUL 1, MINNESOTA
Chicago San Francisco New York

AMERICAN TERRY DERRICK CO. . . . South Kearny, N. J.

Dana C. Buck was appointed manager of the stainless steel bureau of this U. S. Steel subsidiary and **E. L. Robinson** was named to the position of assistant chief process metallurgist.

Mr. Buck began his service with the company in 1941 as stainless steel sales representative in New York. His previous business experience included employment as sales engineer for American Sheet & Tin Plate Company and manager of sales for Peter A. Frasse Inc. He graduated from Pennsylvania State College in 1930 with a bachelor of science degree in metallurgy.

Mr- Robinson, formerly assistant to the manager of the metallurgical division, graduated from Carnegie Institute of Technology in 1933 with a bachelor of science degree in metallurgical engineering. Since that time, he has been employed in various metallurgical positions at the Westinghouse Electric and Manufacturing Company and at the Clairton, Farrell, Vandergrift and Irvin Works of Carnegie-Illinois.

Appointment of **Dr. Richard F. Miller** as development engineer in stainless and alloy steels, department of technology and research, was announced today by the Carnegie-Illinois Steel Corporation.

Formerly associated with U. S. Steel Corporation's research laboratory, Dr. Miller will be responsible for the promotion and coordination of the company's interests in stainless and alloy steel products.

Dr. Miller was graduated from Williams College and received a doctor of science degree from Massachusetts Institute of Technology in 1934. He was employed as instructor in the metallurgical department of Yale University from 1934 until 1936 when he began his service with U. S. Steel at its Kearny, N. J., laboratories.

He is a member of Sigma Xi, honorary scientific fraternity, the British Iron and Steel Institute, the American Society of Metals, and the American Institute of Mining and Metallurgical Engineers.

Dr. Miller and his family will reside at 220 Arden Road, Mt. Lebanon.

Joseph H. Jones, formerly with the metallurgical department of Republic Steel Corporation, Alloy Division, Massillon, Ohio, is now superintendent in charge of Republic Steel's new gun bloom works at Canton, Ohio.

A "MUST"
FOR MODERN BLOWER
Control
Accuracy . . . Sensitivity and the ability to produce repetitive cycles with infallible uniformity make Askania the control of choice for blast furnace blower control.
These same inherent characteristics of the jet pipe principle apply also to . . . control for boosters and exhausters . . . back pressure and bleeder control and control on any prime mover.
Your inquiry for specific details will merit our immediate attention.
JET PIPE PRINCIPLE
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NAVY
ASKANIA REGULATOR CO.
1603 S. MICHIGAN AVENUE, CHICAGO

Obituaries

Herman E. Paetow, chief time study engineer for Jones and Laughlin Steel Corporation, died December 1st after a brief illness. Born in Millbrook, New York, Mr. Paetow graduated from Cornell University in mechanical engineering and entered the employ of Goodyear Tire and Rubber Company as an efficiency engineer. In 1917 he went with National Carbon Company on time study work, later becoming safety director. He became associated with Jones and Laughlin Steel Corporation in 1923 and, with the exception of two years spent as superintendent of efficiency at Kelly-Springfield Tire Company, has remained with that company.

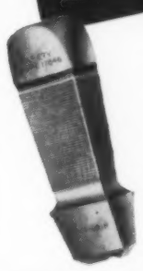
Richard Rowell, assistant electrical superintendent at the Wheeling Steel Plant since 1911, died suddenly of a heart attack in the lobby of the William Penn Hotel, Pittsburgh, at 7:00 P.M. on November 25, 1943. He was 63 years of age.

Mr. Rowell was born in Antwater, England, and came to this country in 1891. His first employment was at the Homestead Works of Carnegie-Illinois Steel at the Homestead Works of Carnegie Steel Company in 1896. In 1906 he went to the Lackawanna Steel Company at Buffalo, where he operated the first ladle crane

VICTORY

DATING AND IDENTIFYING

WITH CUNNINGHAM SAFETY STEEL SYMBOLS



—you know just how long your products have been in service!

Cunningham Safety Steel Symbol Stamps do a dependable marking job —without spalling or mushrooming. Write for complete list of symbols.

M.E. CUNNINGHAM CO.
SAFETY STEEL STAMPS
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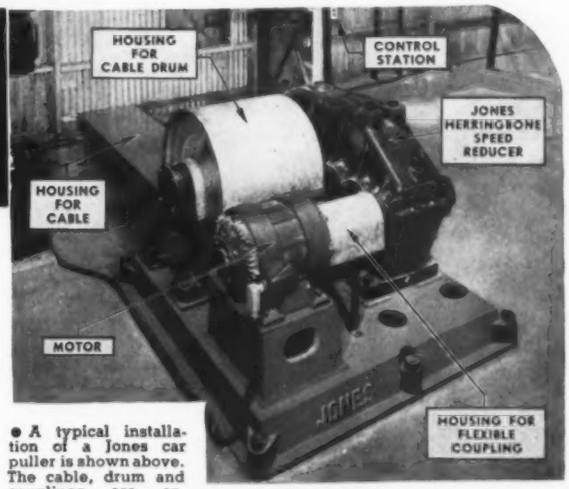
For spotting your cars-
JONES CAR PULLERS

YOU will be surprised how much time can be saved in the spotting and switching of cars by using a Jones car puller. These sturdy, compact units will speed up car handling to the point where they soon pay for themselves in the saving of time and labor.

These car pullers are built by Jones as complete units with motor included if desired, or with base to take standard motor, as supplied by the purchaser. The cable drum is driven by a Jones triple reduction Herringbone speed reducer and the control station may be located at a point to give the operator a clear view of the tracks and spotting positions.

Even in plants where comparatively few cars are handled it has been found that a Jones car puller more than pays its way. Prices and complete information will enable you to judge whether such an outfit might pay out in your plant. Write for complete information.

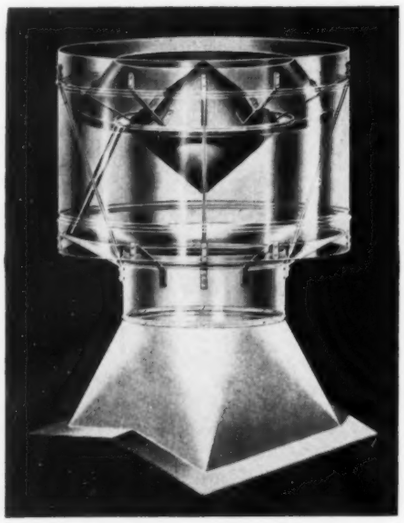
W. A. JONES FOUNDRY & MACHINE CO.
4431 Roosevelt Road, Chicago, Illinois



• A typical installation of a Jones car puller is shown above. The cable, drum and couplings are enclosed by sheet metal housings as an extra precaution in this installation to eliminate all hazard from moving parts.

• A complete Jones car puller unit. These outfits are for use with wire rope and are manufactured in a wide range of capacities to suit the number of cars to be handled in each plant.

Jones
HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS
CUT AND MOLDED TOOTH GEARS • V BELT SHEAVES
ANTI-FRICTION PILLOW BLOCKS • PULLEYS
FRICTION CLUTCHES • TRANSMISSION APPLIANCES



BURT

VENTILATORS

End Production Fag

Unless your mill is properly ventilated, production is sure to lag near shift's end. Workers cannot maintain high efficiency in hot, fume-filled air — accidents happen — spoilage increases.

BURT Ventilators are a capital investment quickly paid for that continue to return dividends to you indefinitely in improved production figures.

Three types of BURT Ventilators are recommended for steel mill installations — the Free-Flow Gravity type illustrated above, the Free-Flow Fan type and the Monovent Continuous Ridge Ventilator. One of them will release new energy in your particular mill most economically and efficiently. Our engineers will be glad to help you make the proper selection — without obligation. Write today for data sheets and information.

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ROOF VENTILATORS • OIL FILTERS
EXHAUST HEADS
955 SOUTH HIGH STREET AKRON, OHIO

SEND FOR CATALOGS
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Burt Engineers are glad to help on plans

and charging machine in the open hearth department. He came to Steubenville in 1907 to take a position as motor inspector at the La Belle Iron Works, and won gradual promotion as a result of his ability.

RICHARD ROWELL

George R. Carroll, assistant superintendent of maintenance at the Aliquippa plant of Jones and Laughlin Steel Corporation died suddenly December 7th. Born in Union City, Pennsylvania, in 1891, Mr. Carroll graduated from Carnegie Institute of Technology

GEORGE R. CARROLL

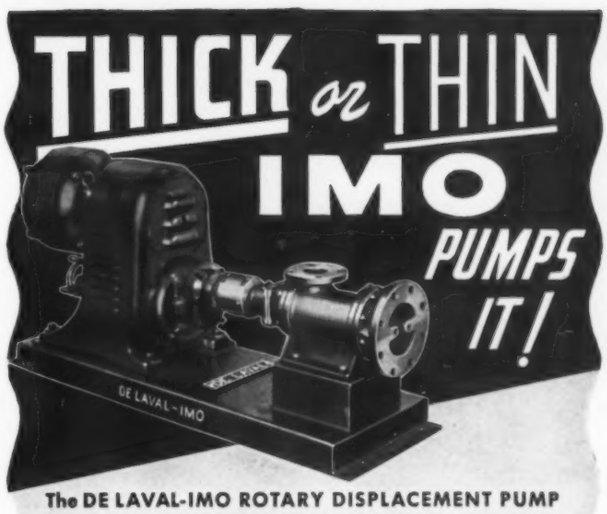
in electrical engineering. After a brief period with Bell Telephone Company, he joined William B. Scaife and Sons, and in 1922, went with Jones and Laughlin Steel Corporation. He was made electrical superintendent in 1930, and with the combination of maintenance departments in 1938, was given his latest position.

Mr. Carroll was very active in Association affairs, being a member since 1926 and serving as national president, 1934-35. He was also president of the Aliquippa School Board and a member of the Rotary Club.

Oliver V. Schauer, sales engineer for the Keystone Lubricating Company in the Pittsburgh district, died November 18th after a short illness. Born in Allegheny,

OLIVER V. SCHAUER

Pennsylvania, in 1878, Mr. Schauer began his lubrication career 26 years ago as a field engineer for Keystone in the tri-state area. He had previously been a mechanical engineer with the L. C. Smith Typewriter Company.



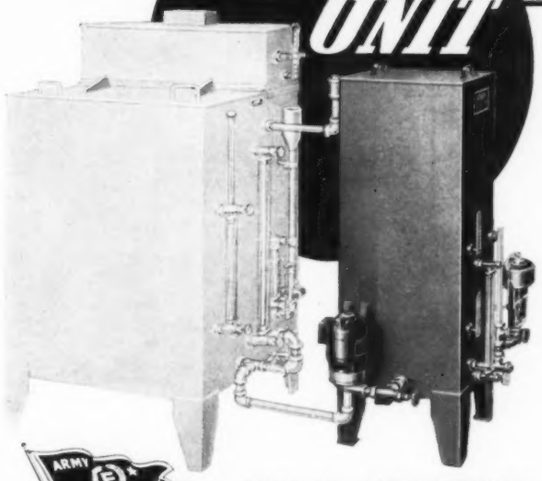
The DE LAVAL-IMO ROTARY DISPLACEMENT PUMP is used for viscosities ranging from that of thin Diesel oil up to the heaviest Bunker C. In the unit here shown, which handles a still stiffer fluid, the outboard end of the pump forms the suction opening, reducing inlet velocities and losses to negligible amounts. The output is controlled by the variable speed drive. • The IMO pump has no valves, no gears and no unbalanced or reciprocating parts. It pumps any oil against any pressure.

Ask for Publication I-103

IMO I MOVE OIL

IMO PUMP DIVISION
of the De Laval Steam Turbine Company, Trenton, N. J.

...A **NEW UNIT** FOR OILS REQUIRING ACID CORRECTION



ARMY NAVY Buy WAR BONDS and STAMPS

SAVES OIL - SAVES EQUIPMENT

BOWSER OIL CONDITIONING UNIT FOR TURBINE & SIMILAR OILS

Today lubricating oils on turbines and similar equipment are doing double duty. Production hours are longer . . . oils don't get a chance to rest or cool off. As a result acids and sludge build up . . . causing oils to be discarded or resulting in scored bearings, sludge formations in cooler tubes and machine pockets or governors. To help overcome these conditions, Bowser announces the new Oil Conditioning Unit. To acid-correct oils now in use. . . . to retard the formation of acid and sludge in new oils. Especially suited for auxiliary use with Bowser Type A and similar gravity filters . . . with Precipitation tanks . . . or, under some conditions, may be used alone. Extremely simple to install and to operate.

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Maximum Production

From Portable Tools

Can be obtained only if tools are kept in constant trouble-free operation.

That's why nearly all makers of air and electric tools use and recommend NON-FLUID OIL to insure long life and dependable service. Accepting their advice will also assure lowest maintenance and repair cost.

NON-FLUID OIL is being used successfully in leading iron and steel mills. Send for instructive bulletin.

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IN U.S. PAT. OFFICE & FOREIGN COUNTRIES

Modern Steel Mill Lubricant

Better Lubrication at Less Cost per Month

OHIO

Maximum Lift MAGNETS

A standard 65" Ohio Magnet
Lifting 5200 lbs. of Pig Iron

Standard round general purpose Ohio magnets are built in sizes from 12" to 65" in diameter.

Average lifting capacity for pig iron or scrap ranges from 200 lbs. to 6200 lbs.

Depending upon the amount of material to be handled, the largest suitable magnet will do it most economically.

Labor cost per lift is the same whether the lift be 200 lbs. or 6200 lbs.

THE OHIO ELECTRIC MFG. COMPANY

5907 Maurice Ave. — Cleveland, Ohio

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One plant that regularly had two or three bearing failures a month writes us, "We have had only one bearing failure in five years since using LUBRIPLATE"... another writes, "Pulled our ball bearing temperatures down from 170° to 130°F"... still another, "If LUBRIPLATE cost $1.50 a pound we could still afford to use it."

BALL BEARING LUBRIPLATE

Over a period of years this outstanding grease type lubricant has reflected superior performance on the general run of ball and roller bearings operating under normal conditions at speeds up to 5,000 R. P. M. and temperatures from zero to 300 degrees F.

Long time users of BALL BEARING LUBRIPLATE everywhere attest to its superiority in providing cool and quiet operation — protection against corrosion, and of major importance, substantial reduction in bearing replacement costs.

Write today for your copy of Bulletin No. 1-43 containing valuable data on the lubrication and care of anti-friction bearings.

7 FACTS ABOUT LUBRIPLATE

1. *LUBRIPLATE produces an ultra-smooth, wear-resisting bearing surface.* 2. *LUBRIPLATE reduces friction, thus lowering maintenance and power costs.* 3. *LUBRIPLATE resists rust, corrosion and pitting.* 4. *Most LUBRIPLATE products are white. LUBRIPLATE assures clean lubrication.* 5. *LUBRIPLATE outlasts ordinary lubricants many times.* 6. *LUBRIPLATE is economical—a little goes a long way.* 7. *LUBRIPLATE is available in fluid and grease types for every need.*

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FISKE BROTHERS REFINING COMPANY
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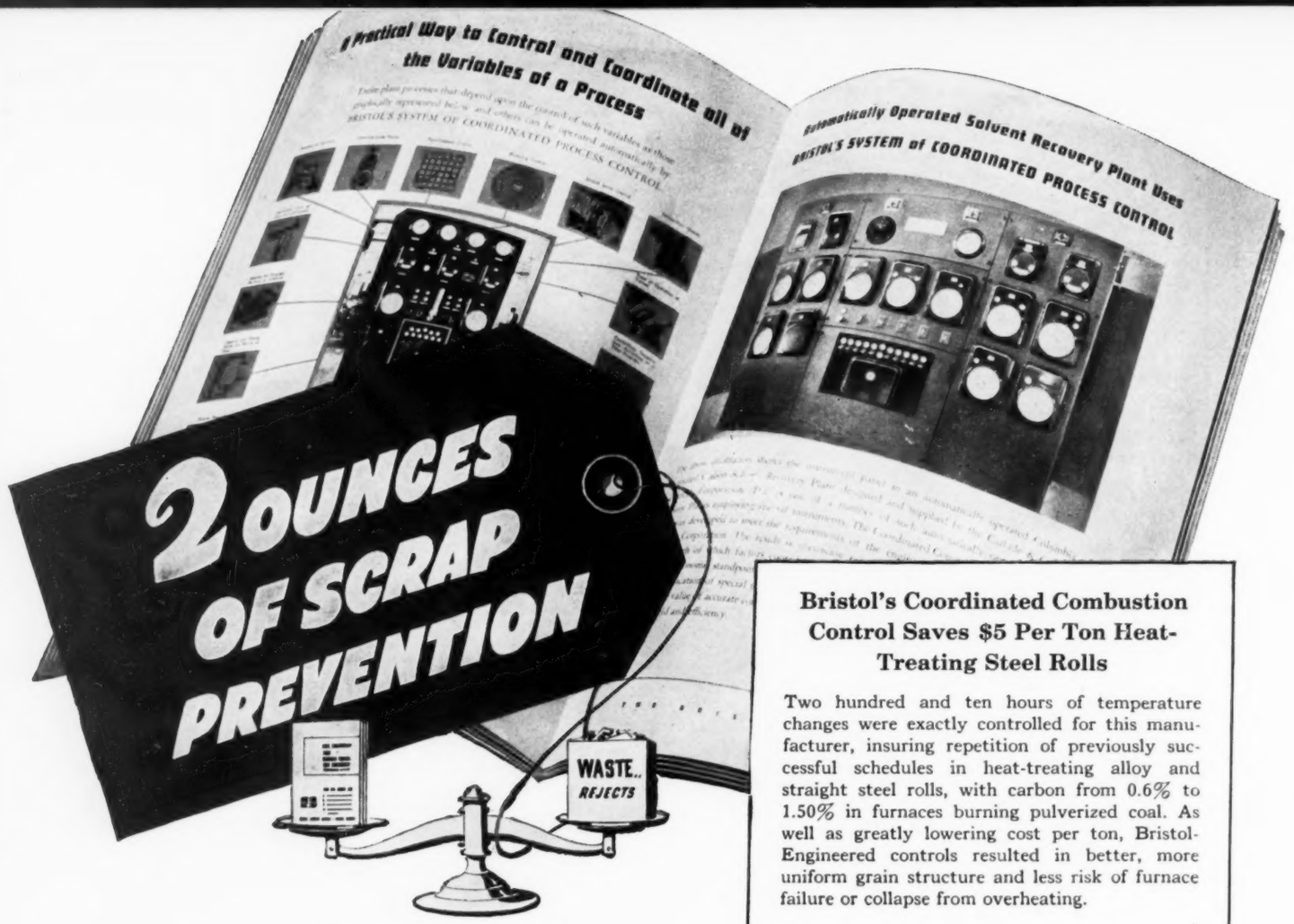
DEALERS FROM COAST TO COAST

LUBRIPLATE

"Its the Film"

THE MODERN LUBRICANT *that Arrests Progressive wear*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Automatically Operated Solvent Recovery Plant Uses BRISTOL'S SYSTEM of COORDINATED PROCESS CONTROL
2 OUNCES OF SCRAP PREVENTION
WASTE.. REJECTS

Saving scarce raw materials by eliminating waste and rejects . . . is only one of the many wartime problems being solved today with the help of Bristol's instrument engineering. In many cases, sending for one of Bristol's instrument-data bulletins has been the first step towards substantial savings.

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1. Lack of skilled men?
2. Shortage of raw materials?
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Here, in one concise bulletin, are the essentials of Bristol's System of Coordinated Process Control, including list of applications and outline of what has already been achieved by many manufacturers in food, textile, metal, plastics, rubber and other process industries. Write for it today, together with any of the other free bulletins described at right, addressing The Bristol Company, 114 Bristol Road, Waterbury, Conn.

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Bristol's Coordinated Combustion Control Saves $5 Per Ton Heat-Treating Steel Rolls

Two hundred and ten hours of temperature changes were exactly controlled for this manufacturer, insuring repetition of previously successful schedules in heat-treating alloy and straight steel rolls, with carbon from 0.6% to 1.50% in furnaces burning pulverized coal. As well as greatly lowering cost per ton, Bristol-Engineered controls resulted in better, more uniform grain structure and less risk of furnace failure or collapse from overheating.

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FREE— These Clear, Concise, Complete Bulletins Sum Up Latest Advances in Instruments for Your Industry

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☐ Bulletin T302 — Describes Bristol's Full-Compensated, Liquid-Filled Recording Thermometers, desirable for a wide variety of critical temperature-measuring problems; nomenclature, parts, schematic diagrams, and partial list of available charts.

☐ Bulletin 536 — Modern pH instruments for exact measurement and automatic control of hydrogen-ion concentration are here described, together with new glass electrode method.

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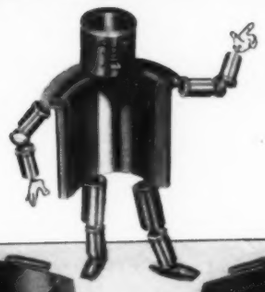
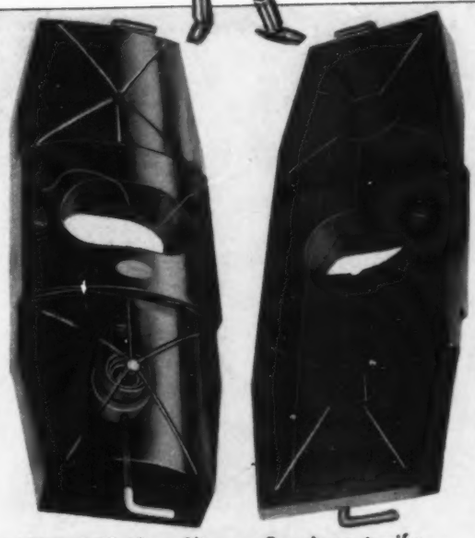
How GATKE BEARINGS Help SPEED STEEL PRODUCTION





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On Universal Couplings of all types and sizes GATKE Slippers give ten times more service than bronze. Eliminate scoring and wear to sockets and spades. Stop severe pounding, vibration and deafening noises. Facilitate proper lubrication and avoid grease slinging.

They are moulded to finished dimensions for replacing ordinary Slippers without machine shop work.

Tremendous Wear Life—Reduces replacement delays and bearing maintenance 90% and more.

Accurate Holding of Gauge—Maintains close tolerances—avoids screw down delays and minimizes "off section" losses.

Eliminate Hot Necks—No waiting for necks to cool. No premature neck breakage due to heat checking.

Lowest Friction—Permits heavier reduction per pass.

Furnished Ready to Install—No machine shop work required.

Through savings of power, maintenance, and grease, GATKE Bearings *contribute mightily to the War Effort.* They are moulded to machined accuracy for replacing metal bearings quickly and at insignificant cost.

Whatever your service send specifications covering the application for Facts and Figures.

The great economies of GATKE Bearings are not limited to Roll Necks. They are giving wonderful results on Spindle Carriers, Table Rolls, Guide Rolls, Conveyors, Cranes and other troublesome applications.

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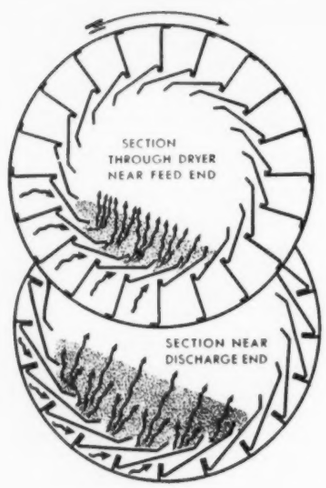
For Roll Necks, Universal Couplings, Spindle Carriers, Table Rolls, Cranes, Acid Resisting Service, and Other Tough Jobs.

How Ammonium Sulphate is Dried at National Steel Co. of Brazil

● This Link-Belt Roto-Louvre Dryer installation is similar to an application of this unit drying ammonium sulphate at the new mill of National Steel Co. of Brazil, except that the reclaim hopper is located at floor level for hand loading instead of as shown here. The high efficiency of this method of drying ammonium sulphate has been proved by numerous installations. It (a) dries salt as delivered direct from centrifuges; (b) dries salt *after* it has been reclaimed from storage; (c) reduces and screens to marketable size, lumps that have been formed by prolonged storage of wet salt, or dried salt that has accumulated moisture during the storage period.



A large volume of dry hot air easily penetrates the relatively thin bed of material near the feed end of the dryer for maximum heat transfer where greatest evaporation can take place. As the material moves forward the bed becomes thicker and the air passages get smaller so that a reduced volume of heated air will penetrate the bed—thus preventing overheating.

9326-A

ROTO-LOUVRE DRYER Brings These Advantages

in Drying Ammonium Sulphate and Metallurgical Coal

1. Applies greatest heat volume at the start, where moisture is highest.
2. Gently mixes the material. No cascading to cause degradation of the crystals. No sliding to cause excessive wear.
3. All heated air entering the dryer must come in intimate contact with the product.
4. Thorough, uniform drying to less than 0.1% in a single pass is assured without overheating.
5. The method employed of balancing the inlet and exhaust gases, eliminates the need of a dust collecting system, other than a single cyclone.
6. And it does all these things in the least possible floor space, and at lowest cost.

LINK-BELT COMPANY

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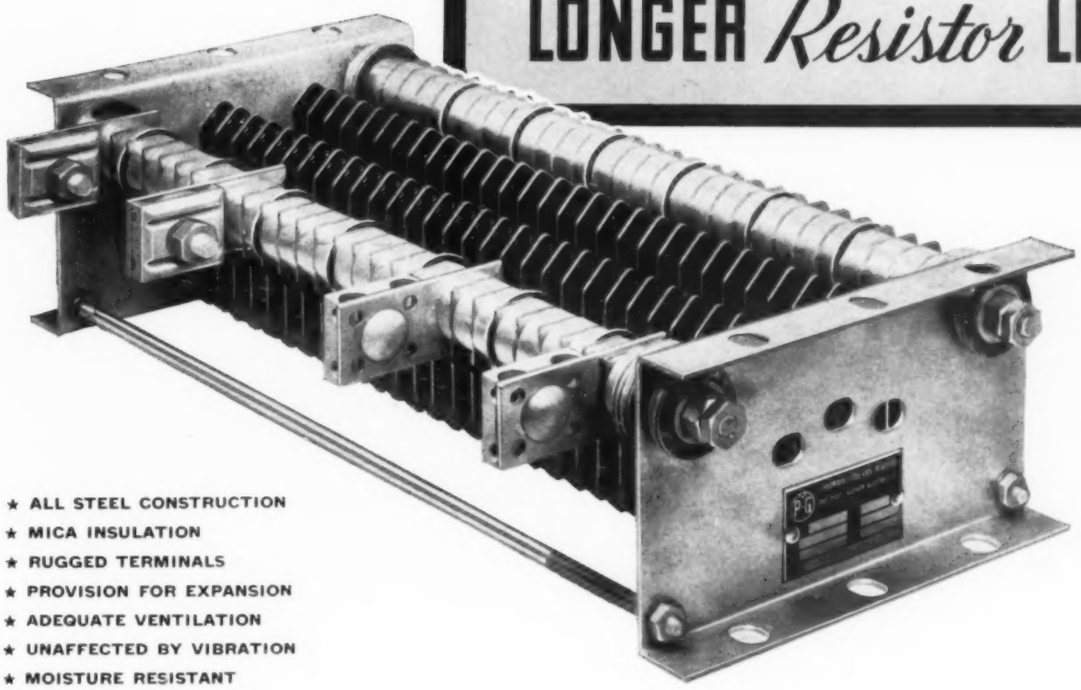
LINK-BELT
ROTO-LOUVRE HEAT DRYER

P-G.....THE *Answer for* LONGER *Resistor* LIFE



★ ALL STEEL CONSTRUCTION
★ MICA INSULATION
★ RUGGED TERMINALS
★ PROVISION FOR EXPANSION
★ ADEQUATE VENTILATION
★ UNAFFECTED BY VIBRATION
★ MOISTURE RESISTANT
★ CORROSION PROTECTED

Longer resistor life as afforded by P-G is the result of exclusive features of design coupled with use of the most durable raw materials.

Grid plates are shaped for maximum ventilation and heat dissipation with tests showing unusually even temperatures over the entire working surface. Thus, "hot spots" one source of resistor trouble, are eliminated.

Unique methods used to mount gride plates in their supporting assemblies is equally important to long resistor life. P-G "floating bolt" construction allows the resistor to expand as operating temperature builds up. Thus damage from expansion, another source of resistor trouble, is minimized.

These and similar practical features of design, plus Steel and Mica as basic materials make P-G the answer for longer resistor life. Ask for Bulletin No. 500 for more detailed information.

P-G

"The Resistor you can Install and Forget"

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI, OHIO

for THIS battle, G.H.Q. is at YOUR own desk!

★ Here's how you—yes, YOU—can carry out a smashing "pincer movement" against the Axis. Swing in on one flank with increased production of war goods! Drive in on the other with redoubled purchases of War Bonds through your Pay-Roll Savings Plan!

You're an officer in both of these drives. Your personal leadership is equally vital to both. But have you followed the progress of your Pay-Roll Savings Plan as closely as you have your production?

Do you know about the new Treasury Department quotas for the current Pay-Roll Allotment Drive? *Quotas running about 50% above the former figures?* You see, these new quotas are based on the fact that the armed forces need more money than ever to win the war, while the average worker has more money than ever before to spend. Particularly so, on a *family income* basis—since in so many families several members are working, now.

Remember, the bond charts of today are the sales curves of tomorrow! Not only will these War Bonds implement our victory—they'll guard against inflation, and they'll furnish billions of dollars of purchasing power to help American business re-establish itself in the markets of peace.

So get this new family income plan working at once. Your local War Finance Committee will give you all the details of the new plan. Act today!

This advertisement prepared under the auspices of the War Advertising Council and the U. S. Treasury Department.

LET'S KEEP ON Backing the Attack!

This Space is a Contribution to America's All-Out War Effort by

IRON AND STEEL ENGINEER

THESE FOLDERS
Give You The Dope . . .

6 Page Folders with Information on —

* 1. SYNTHITE PG-1
* 2. SYNTHITE PG-4
* 3. Specifications
* 4. Methods of Insulating
* 5. Vacuum Impregnation

These folders are especially designed to help engineers, electricians, etc., in insulating electrical units. A section is devoted to the proper method of insulating units as determined by the DOLPH Laboratories. This section also gives information on pre-heating of units and dipping.

Another section will aid those who vacuum impregnate their units. The method described has generally been accepted as standard for impregnating all types of electrical units with both the conventional and synthetic insulating varnishes.

These folders are yours for the asking together with any other information you may desire regarding insulating varnishes.

Dolph's
JOHN C. DOLPH COMPANY
Insulating Varnish Specialists
166A EMMETT ST. NEWARK, N. J.

DEEP... LEGIBLE MARKING!

... with Matthews New No. 204
MARKING MACHINE

MARKS ROUND OR FLAT PARTS
A range of parts up to 6" in dia. or thickness . . . legibly marked with this NEW General Purpose Marking Machine Round parts marked with flat dies . . . flat parts marked with roller dies

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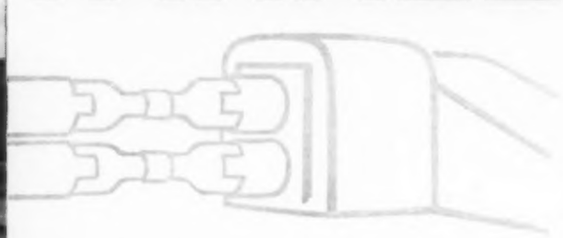

2-HIGH MILL

FOR COLD BREAKDOWN OF BRASS SLABS

FARREL ROLLING MILL MACHINERY

Rolls
Rolling Mills
Rod Mill Tables and Manipulating Equipment
Universal Mill Spindles
Rod Coilers
Gears
Mill Pinions
Pinion Stands
Gear Drives of any Capacity
Flexible Couplings
Roll Grinding Machines
Roll Calipers
Lead Presses for Pipe or Rod

HERE is a modern 26 in. x 36 in. rolling mill, for operation at a speed of 125 feet per minute, which was recently installed in a war plant. Used for cold breaking down of brass slabs, this 2-high mill is of unusually heavy construction to handle large reductions.

A feature of the design is the double motor screwdown which has the two screws interconnected by an electro-magnetic clutch. This screwdown is easy to manipulate and yet sets the rolls with extreme accuracy. Screwdown gearing and bearings are force feed lubricated by electrically driven and interlocked pump.

Rolls are of forged alloy steel, heat-treated and hardened. The top universal spindle and the top roll are hydraulically counterbalanced.

The mill is driven by a 1000-horsepower motor through a combined reduction gear drive and pinion stand. The alloy steel gears and mill pinions are accurately generated with Farrel-Sykes continuous herring-bone teeth, and are mounted in anti-friction roller bearings. Electrically driven and interlocked oil pump provides spray lubrication of all gear teeth and flood lubrication of the bearings.

For further details of this mill or information regarding any of the other machinery listed on this page, please write to the address below.

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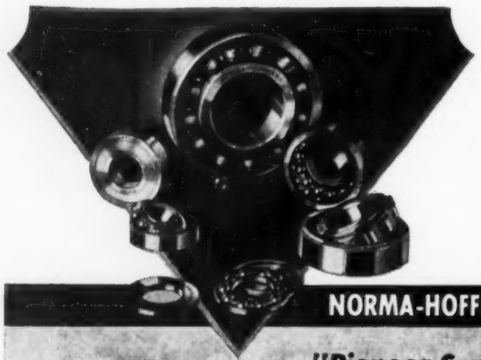

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Opening-time of d-c circuit breakers offers an example of a characteristic in which I-T-E equipment gives choice ranging from conventional standards to the fastest circuit breakers available. The description below features the type of I-T-E breaker that is used when extremely rapid opening can be used to advantage.

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ARC CHUTE is provided with blow-out coils and magnet, internal arc horns, secondary arc horns (visible at top) and cooling baffles. Extinction of arc, following separation of arcing contacts, is extremely rapid.

MAIN CONTACT BRIDGE is provided with silver - alloy - block contacts. Arcing contacts are enclosed in the arc chute.

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CLOSING SOLENOID HOUSING protects the coil and armature against entrance of dust and accidental damage.

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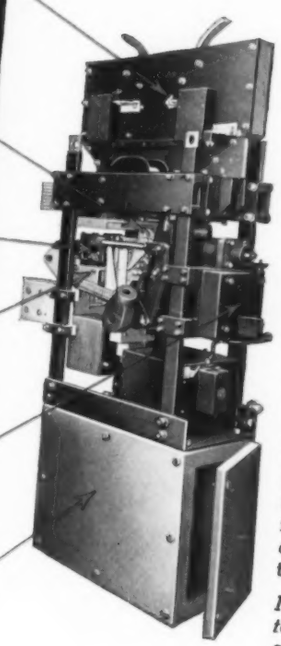

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For modern d-c systems in steel mills, with generators, converters or rectifiers connected in parallel, the type FB circuit breaker has ability to limit fault currents to very low values. Opening time of the FB is of the order of 2/5ths of a cycle (60 cycle basis). So quickly does interruption take place that currents rising at a rate of several million amperes per second are kept from doing harm to the system or the equipment connected in it.

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